What It Means to be Lazy

By DONALD A. LAIRD

SCIENTIFIC AMERICAN

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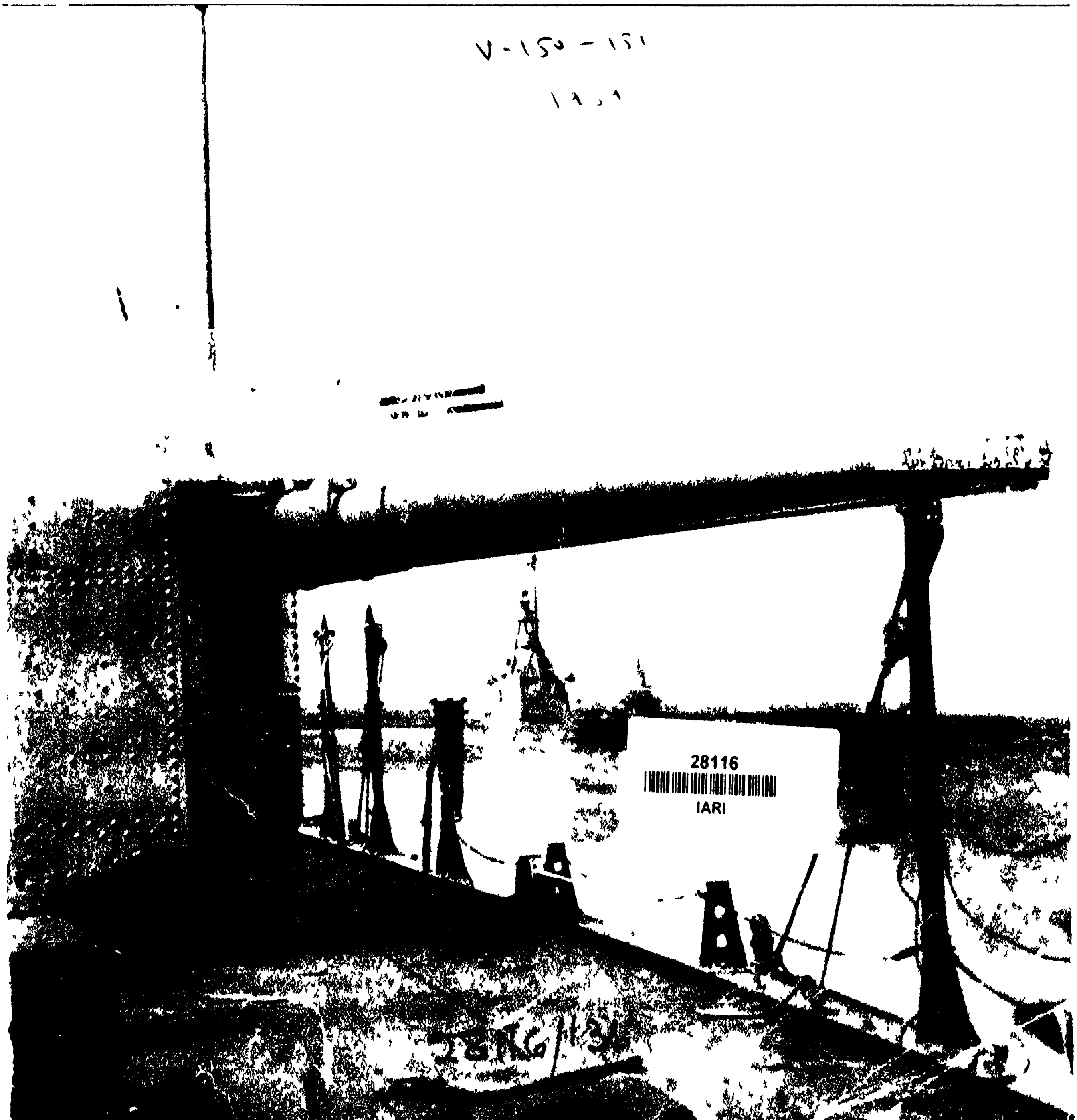

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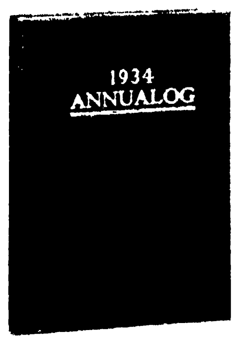

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SCIENTIFIC AMERICAN

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ACROSS THE EDITOR'S DESK

SO many of the motor car models of 1933 have been streamlined to a certain extent that the trend of the industry is obvious. Cars for 1934 will undoubtedly show a continuance of this tendency toward the application of aerodynamics to the automobile. It is apparent that manufacturers are conducting an "educational campaign" for the public, and gradually making the large group of car users accustomed to the radical changes that will have to be made before the real benefits of streamlining may be reached. Just as the car of 10 years ago appears odd and clumsy in appearance beside the sleek models of today, so those of 1933 will compare, to their detriment, with the vehicles of 1943. Of course, the motor car driver wants to know just what streamlining means to him. Will it be of large economic importance, or will it be just another selling point with little actual significance? We have in preparation one, and possibly two or more articles on this subject that will answer many of the pertinent questions which have been asked and which will surely arise in greater numbers in the near future. We expect to present the first of these articles next month.

●

"Blister Busters." This alliterated phrase is the title of an article by Charles Lathrop Pack, president of the American Tree Association, which is scheduled for early publication. The blisters are those of the blister rust that attacks white pines and renders the wood useless for commercial purposes. The "busters" are the Division of Blister Rust Control of the United States Department of Agriculture assisted by the men of the Civilian Conservation Corps. "This invader," writes Mr. Pack, referring to the blister rust, "is a modernist in methods of warfare. He employs the most vicious and subtle of the tools of death—germ warfare." How the blight of this rust spreads, what steps are being taken to control it, and how successful the campaign has been so far, make an article that is at once both interesting and informative to anyone who has ever used wood in any form—and that includes everyone.

●

". . . Campaigns against smoke and dust get satisfactory results only in cities where physicians take a leading hand. . . . Only recently have leading combustion engineers fully demonstrated their ability to fill a prescription for the smokeless and dustless operation of fuel burning plants. . . ." Thus writes Dr. W. W. McFarland, Director of Public Health, Pittsburgh, Pennsylvania, in an article entitled "The Doctor Looks at Smoke and Dust," scheduled for an early issue. Solid particles of foreign matter in the atmosphere, particularly in winter, constitute a definite health menace in many localities, therefore Dr. McFarland's impartial yet searching survey of the whole situation is of vital importance to every municipality.

●

The sundial, known to the ancients and widely used today as a garden ornament, may, when properly designed, be used as a practical and accurate timekeeper that will indicate mean solar (watch) time. Definite instructions for making various types of dials are difficult to obtain and when found are often vitiated by the inclusion of irrelevant material. We have, however, obtained a series of articles from R. Newton Mayall and Margaret Walton Mayall, which get right down to fundamentals and give concrete directions as to how to proceed. Many inquiries from readers on this subject lead us to believe that these articles, the first one of which will appear next month, will be given a warm reception.

●

"Is it true that only 12 people are able to understand the Einstein theory of relativity?" This is a question that is often asked when the name of the great physicist is mentioned. According to Joseph B. Nichols, writing in next month's number, it all depends on what is meant by "understanding Einstein." Mr. Nichols' article, which was read and approved by Professor Einstein himself, carries the following title: "You Have One Chance in a Hundred to Understand Einstein." Those are not bad odds, so be sure to read the article, and find out on which side of the fence you fall.

●

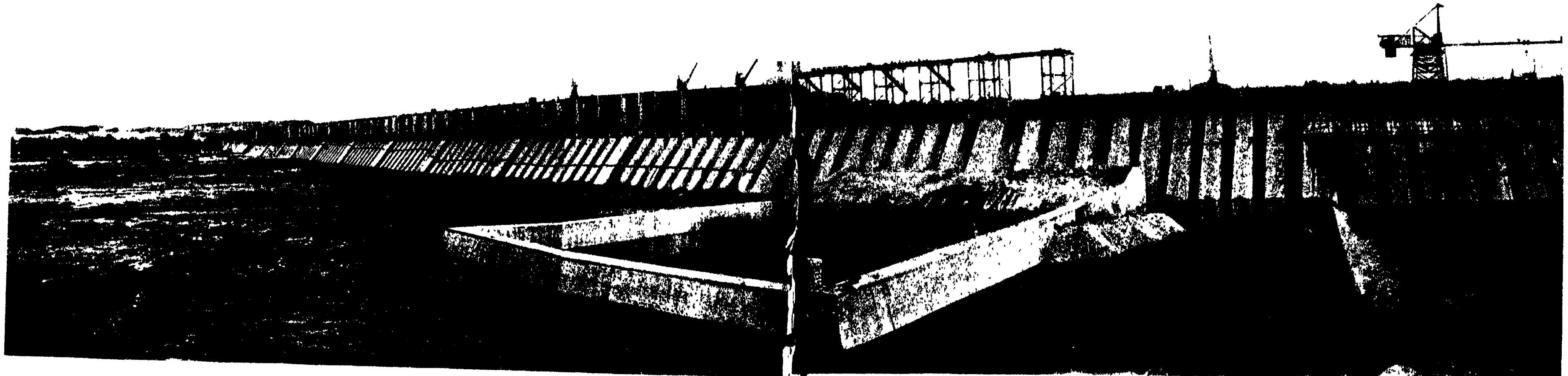
Ultra-short radio waves are coming more and more before the public, not only because of the work which Marconi is doing with them, but also because of the wide-spread applications that the waves promise in many phases of human existence. For these reasons, we have been particularly fortunate in obtaining, from Prof. F. Zwicky of the California Institute of Technology, an article on the subject of ultra-short radio waves that sketches their history, their nature, and their technical and scientific importance. This article, scheduled to be published soon, tells the story of the extreme lower end of the radio wave bands in the clearest and most concise manner that we have ever seen.

Orson D. Munn

Editor and Publisher

LEE A. STRONG

THAT a man who lacks a formal education and may not add a string of university degrees to his name cannot hope to gain a serious hearing in the world of science appears to be the belief of many – especially of some who complain to the editors of scientific journals that their ideas are not taken seriously for this reason. That this is not the case is proved by the attainments of several men of science whose education was not spoon fed to them. For example, the dean of one of America's best universities never went to college, yet he is a high-ranking paleontologist as well as a dean Another man who has no college degree but educated himself, yet who "got there" in the world of science, is Lee Strong, the new Chief of the Bureau of Entomology of the United States Department of Agriculture. His life work has had to do with the prevention of the spread of plant pests and diseases saving millions (probably billions) to farmers and the nation -sometimes by their eradication, sometimes by quarantines which prevent their introduction from other lands



Panorama showing construction work in progress on the Assouan Dam in 1932

Construction work behind gate No. 2 recess locks of Assouan Dam. It will be noted that in this work, as in the original and in the first heightening, a large proportion of the structure is made up of stone rather than reinforced concrete

Heightening the Assouan Dam

Unusual Engineering Problems Are Involved in Egypt's Second Heightening of the Famous Assouan Dam, Greatest of Massive Monuments on the Nile

By HAMILTON M. WRIGHT

THE most marvelous of Egypt's wonders is nearly complete. In January, it is estimated, the second heightening of the Assouan Dam, which blocks the Nile River at Assouan, 551 miles south of Cairo,* will have been finished at a total cost, from commencement to final completion, of over 12,000,000 Egyptian pounds.

The capacity of the original dam built in 1902 and once before heightened in 1912, will be approximately doubled by this huge operation, with vast benefits to the Egyptian farmer from the extra two and one half billion cubic meters of water stored. The new waters will allow the irrigation of approximately 1,000,000 acres, representing about one seventh of the Egyptian soil now under cultivation. The Egyptian Government proposes ultimately to double its present farm acreage as its comprehensive plan for the storage of Nile waters develops, until 13,000,000 acres, the estimated limit of cultivatable land in Egypt, is reached.

The second raising of the Assouan Dam, one and one quarter miles long, embodies many highly technical considerations. The first heightening was a relatively simple affair although it increased the capacity of the Assouan Reservoir from one billion to two and a half billion cubic meters of stored waters. The chief problem in the present heightening was in determining some different and equally effective method by which the dam could be raised, since preliminary investigation revealed that it would be unsound to use the same methods for the second elevation as were followed in the first.

IN November, 1929, the Egyptian Government appointed an international committee of engineers to discover a practical way of heightening the Assouan Dam. The committee was officially called the International Technical Commission and consisted of Colonel Hugh L. Cooper, an American engineer of note, H. F. Gruner, of Switzerland, and W. J. E. Binnie, of England. Their duties were to look over all plans submitted for the heightening and to submit any proposals of their own for the accomplishment of the gigantic task.

They submitted a program which was accepted by the Egyptian Government and work was begun early in 1929. Some idea of the huge amounts of material employed may be had from the engineers' construction plans. Totals of 176,000 cubic meters of granite rubble masonry, 168,000 cubic meters of concrete and masonry, 425,000 cubic meters of granite masonry, besides thousands of tons of concrete and iron rods, tubing, and sheathing are provided for in the plans of the technical commission.

The designs of the commission called for a unique procedure in raising the dam. The existing construction, originally a monolith, had been thickened during the first heightening from 1907 to 1912, but it was feared that a repetition of this method devised by Sir Benjamin Baker, England's engineering genius, would defeat its purpose. Accordingly, an unusual procedure for this important work was adopted. The plan, as executed, called for sliding buttresses, leaning on, but not bonded to, the downstream surface of the dam which is built of rough "rock faced"

*See map on page 259, December, 1933, *Scientific American*, with the article "Harnessing the Nile"

are left in the heightening blocks and when the job is completed the rods are consolidated into position by liquid cement being grout-forced about them.

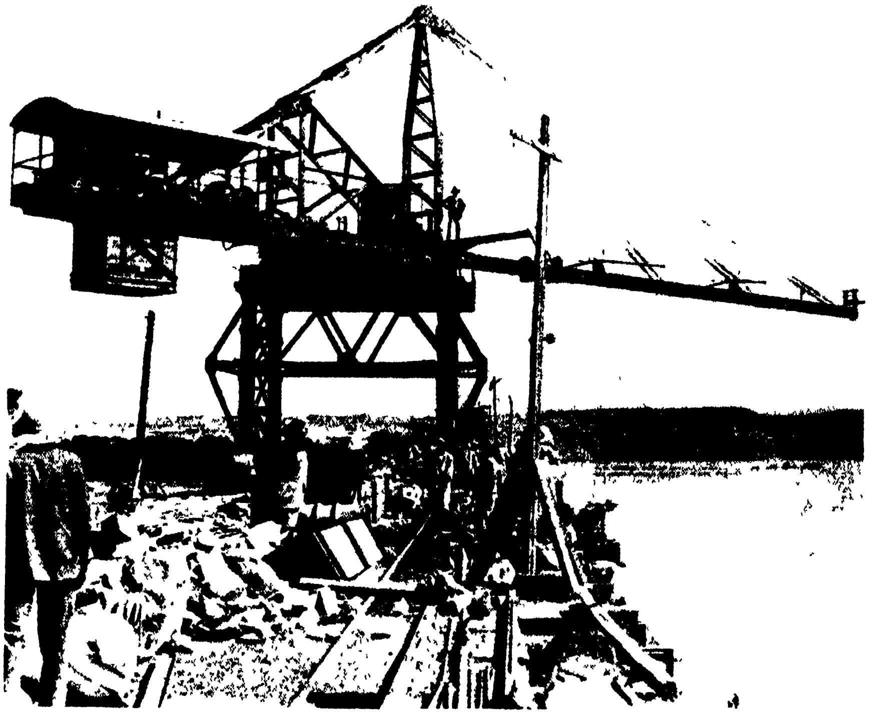
If all of the silt carried into the Assouan Reservoir by the Nile within the next 50 years were deposited there (and this cannot occur), 150,000,000 cubic meters of silt would be left in the reservoir basin. The reservoir has a capacity of 5,000,000,000 cubic meters, precluding any danger of an appreciable decrease in its capacity. The sluices in the dam have been constructed at low levels and during flood times are kept fully open to allow the turgid flood waters to flow out freely.

The new backwater of the Assouan Dam will extend beyond 184 miles south of the dam, its farthest point at present. As in the past, land totally submerged will be expropriated and land covered with reservoir water for a part

granite that was smoothed to a mathematically true plane before the new buttresses were laid against it. When this was done, sheets of stainless steel were laid on and the masonry of the new buttresses was built against them. A property of the stainless steel which insured its successful usage is that cement mortar and concrete fail to stick to it. The result of this form of construction is a series of buttresses leaning heavily against the downstream surface of the dam, assisting it to withstand the increased pressure being borne upon it by the enlarged reservoir, but entirely free to contract and expand in accordance with wide variations in daily and seasonal temperatures which in this part of the world are known to vary as much as 110 degrees, Fahrenheit.

THE buttresses are all built at this writing. The only part of the project still unfinished is an eighth of a mile along the top of the western extremity of the dam. This part of the work will be concluded in the same manner as the much greater portion already elevated. Sections seven meters (23 feet) wide by seven meters high, interspaced by seven meters of the old dam top, are first built to cover a given distance on the original crown instead of heightening a part of the dam wall as a unit. Engineering practice demands that this method be followed instead of building the heightening wall in one operation since a long masonry construction could have insufficient allowance for contraction of its materials. To heighten the Assouan Dam in a single operation with a super-structure one and one quarter miles long would thus be impossible. Four months after the sections have been built, during which time they have been allowed to set, the intermediate sections are constructed. An asphalt seal is inserted in the joints between each pair of sections, the upstream surface of the joints being caulked with lead wool. Each asphalt seal is provided with pipes so that at any future time, the seal may be tightened up with steam if necessary.

Another interesting feature of the work partially done is the reinforcement of the upstream surface of the solid dam by means of hollow stainless steel rods, to resist possible tension on the upper portion of the dam when the reservoir is full. To accomplish this, holes have been drilled from the present roadway level on its top right through the dam and two meters into its bedrock foundation which is a wide vein of red granite spanning the Nile River basin at this point. Corresponding holes



At top of page: **The rock for facing the dam came from the ancient quarries from which obelisks and giant sculptures once were cut**

Above: **The type of traveling crane used on top of the dam for handling the heavy stones and great quantities of other materials**

At right: **View of construction work on lock No. 1, showing progress of work in the early stages. Interesting details are visible**

of each year will be partly compensated for. Some of this area will be used to grow crops during the period of time it is exposed.

The Egyptian Government has already drawn up plans for the allotment of the two and a half billion cubic meters of water that will be available from the Assouan Dam next year. Thousands of acres of barren and inadequately irrigated land, ranging in location from the Assouan province down along the Nile River Valley to the Delta, will be rendered highly productive by this mineral bearing water.

The scheme in brief provides for the distribution of the stored waters as follows:

1 Four hundred million cubic meters will be used to complete the irrigation facilities of 400,000 feddans (1¹/₁₀ acres = 1 feddan) of farm land now inefficiently irrigated in the Northern Delta and which lie within the drainage pump zones now under construction in this region.

2 Four hundred million cubic meters to guarantee rice cultivation in the Northern Delta within the provinces of Behara, Gharbia, Dakahlia, and Sharkia

3 Six hundred million cubic meters for irrigation of the Sharqi lands and to improve crop rotations in Middle Egypt and the Delta

4 Five hundred million cubic meters to convert 100,000 feddans in Upper Egypt from basin to perennial irrigation in the Assouan and Giza provinces and part of the Nile "Sahels"

5 Four hundred million cubic meters to convert 100,000 feddans of wasteland in the Northern Delta drainage pump zones to productive farmland

6 Forty million cubic meters to convert lands in the vicinity of Kena and Luxor from basin to perennial irrigation. This step will provide cooler weather for the towns in this area.

7. One hundred and sixty million cubic meters for subsidiary objectives

A large part of the drainage facilities of the farmlands to benefit by the new water supply has already been completed and every effort will be made to complete in entirety the drainage systems of these lands in time to receive the additional water supply that will be available from the heightened dam in the winter of 1934.

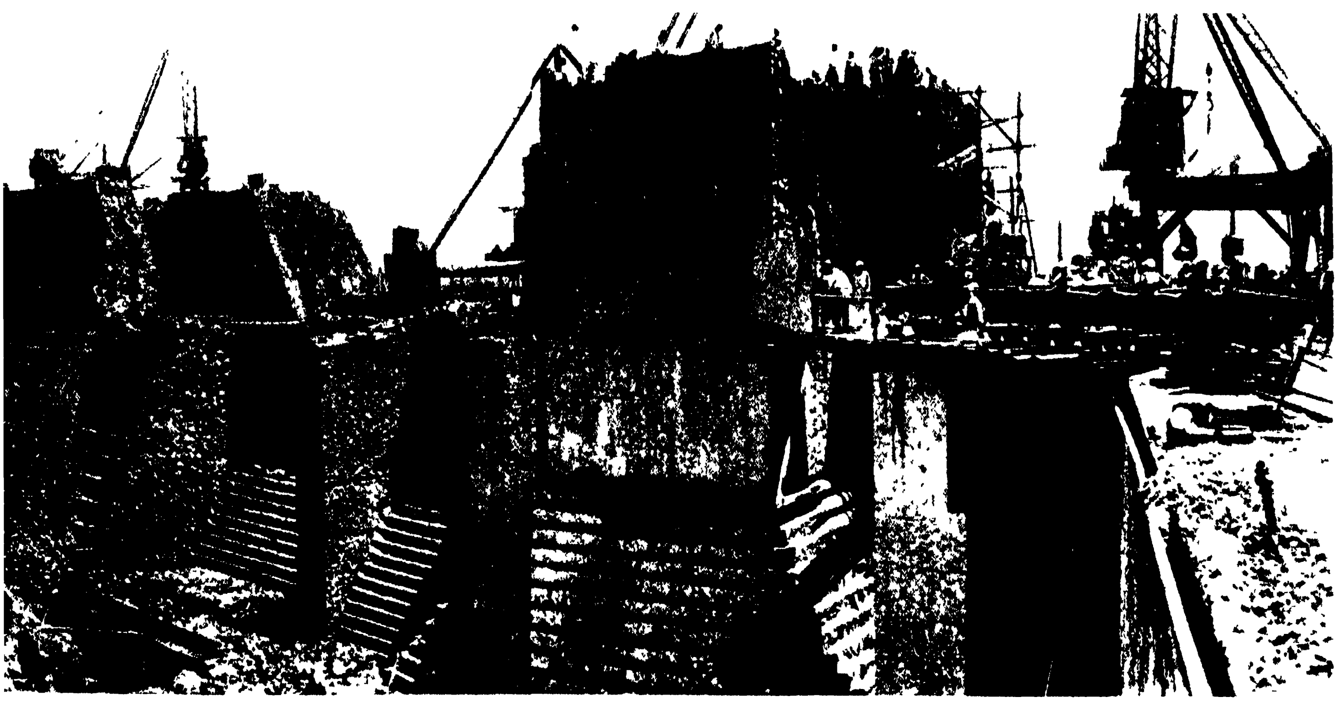
Although the original Assouan Dam was first heightened in the years from 1907 to 1912 and many other works for controlling the Nile water supply were built during the first part of the present century, this construction has been insufficient due to a steady increase in Egypt's population and a fast improving standard of living which required a more intensive realization of Egypt's agricultural resources.

The object of the Assouan Dam, which was the greatest single irrigation project in the history of Egypt, was to store one billion cubic meters of water for the summer requirements of 300,000 feddans converted in Middle Egypt from basin to perennial irrigation. The dam was then 128 feet high and one and one quarter miles long The cost of construction was about 15,000,000 dollars In 1904, it was found necessary to protect the rock downstream of the dam by erecting masonry aprons This work took two years to accomplish and cost over 1,500,000 dollars.

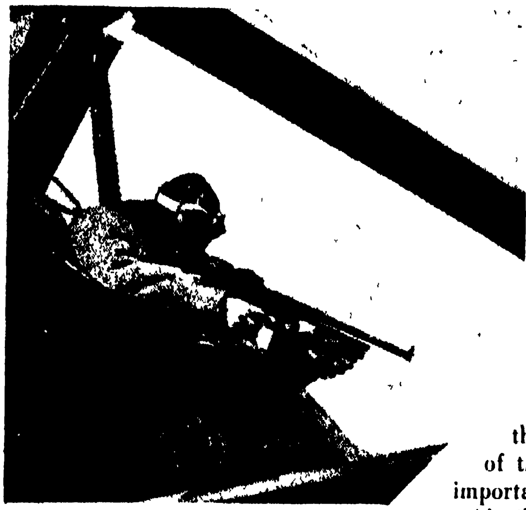
The storage capacity of the dam was increased from one billion cubic meters to two and a half billion cubic meters, and 100,000 feddans of desert land in Middle Egypt were added to Egypt's farm area when the dam was first heightened by 16½ feet This construction involved the thickening of the dam by the building of a five-meter wide block of stone on its downstream face, and a corresponding heightening. The money spent for this work amounted to 6,100,000 dollars. At that time, "free drainage" schemes were not in operation in the Northern Delta, beginning about 551 miles north of the dam. Strangely enough, most of the delta lands require irrigation in the summer but a difficulty arises in draining a large part of this, after it is irrigated by flooding, because of the fact that it is below the level of the Mediterranean Sea, so drainage pumps were necessary

THE drainage system in the Northern Delta is now undergoing important modifications through government work so that the additional supply of water to be created when the present heightening of the Assouan Dam is completed can be fully utilized in summer irrigation for this region Sixteen pump stations, located at strategic points are now under construction throughout the Northern Delta and are to be electrically driven by power supplied from three central power stations located in the eastern, central, and western parts of the delta A number of these stations are already completed and the remainder are in various stages of completion The main and subsidiary pumping stations are all to be connected by a high power transmission line totaling 181 miles in length.

Fifteen irrigation stations, being erected by the Egyptian ministry in Assouan province near the dam, will feed 52,000 feddans of high land with water from the enlarged reservoir This project is planned for completion in the near future



Hovering Police of the Air



A police officer in an Autogiro

AERIAL police forces are by no means new: New York City has a fleet of police planes and other cities own or occasionally use planes for law enforcement purposes. While the advantages of conventional planes are great, particularly the high speeds that may be attained, there are many disadvantages. Some of these are overcome by the use of the Autogiro. This type of ship may be made to hover almost stationary in the air and so become a mobile observation station or machine-gun nest. Thus the 'giro offers to police work the facilities of high speed when needed, together with slow flight when desired, and the ability to land and take off in restricted areas.

A recent experiment was undertaken by Police Chief Theodore Hallowell of Cheltenham Township, Pennsylvania, in co-operation with officials of the Autogiro Company, to determine whether it is practical to apprehend escaping criminals from a 'giro, when police on the ground have either lost the trail or are far away.

To demonstrate the possibilities of such work, an empty automobile with a locked steering wheel set to drive the car in wide circles was employed. The car was set in motion and, with J. Paul Lukens at the controls and Chief Hallowell in the cockpit with a submachine gun, the plane took off. Firing at the speeding automobile was done at altitudes of 300 to 500 feet, with occasional bursts at heights as low as 50 to 60 feet.

Of 77 bursts of shots, 35 found their mark. Thirteen pierced the top of the car and it was raked from rear windows to windshield in order to make sure that the imaginary occupants were put out of business. One burst tore off a front tire and another pierced the vacuum tank, after which the car burst into flames. One of the first shots passed directly through the driver's seat, which would undoubtedly have been sufficient to effect the capture of a bandit's car in actual conflict.

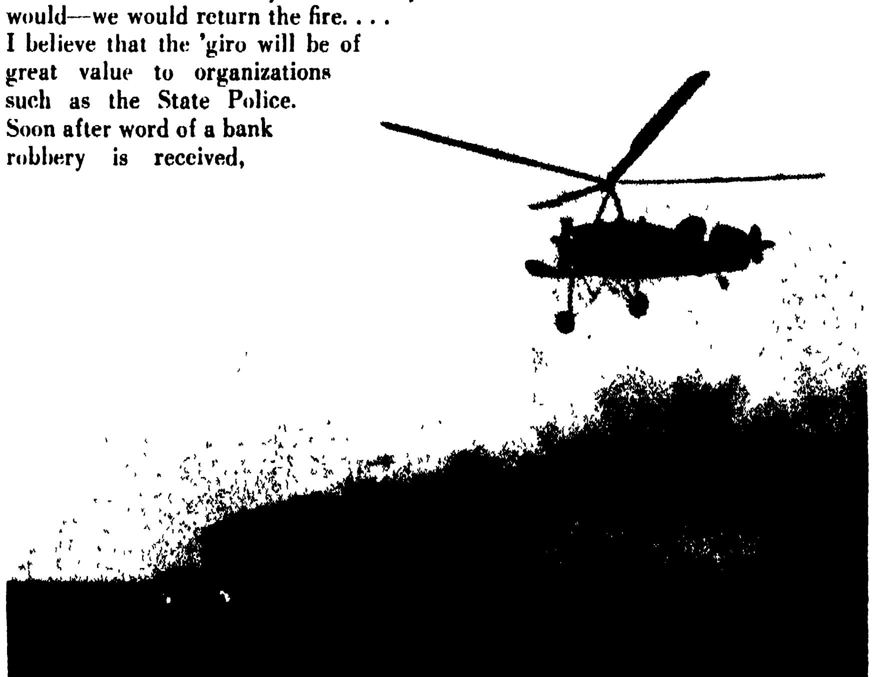
In commenting upon the demonstration, Chief Hallowell, who is rated as an expert machine gunner, was enthusiastic in his praise of the skill of the pilot. "A good pilot is more important than a good marksman," he said. "With a good pilot, an Autogiro can be brought to a full stop, or it can hover over the car it is pursuing. Then the marksman can get in his work."

THE location of the particular car sought should be a comparatively simple matter, in the opinion of Chief Hallowell. Once a description of the criminals' car has been broadcast by radio or the teletype, and the car has been sighted, it would of course be necessary to make certain that the car was the one sought before an attack could be made.

"Warning shots would be fired," said Hallowell, "and the 'giro would hover low. If the car continued on its way, we would follow. But if the occupants started to fire on us—as they undoubtedly would—we would return the fire. . . . I believe that the 'giro will be of great value to organizations such as the State Police. Soon after word of a bank robbery is received, the plane can be in pursuit, and after the fleeing car has been spotted, there can be no question of the outcome. If necessary, an Autogiro can be landed in the middle of the road."

Other lines of police work than the pursuit and capture of bandits and the like are open to the 'giro. Searching for lost hunters, campers or aviators in remote districts, directing congested traffic, patroling hunting and fishing territories on the watch for game law violators during the open season—all are possibilities. In fact, they have already been done. A plane that was forced down during bad weather in a mountainous area of western Pennsylvania was wrecked. After more than a day of fruitless search, a 'giro took off and within half an hour had located the remains of the plane. Since no sign of life could be seen, the ship was not landed, but returned to the nearest town to give directions as to the location of the wreck. Had any sign of life been apparent, the pilot stated that he could have made a landing within three quarters of a mile from the scene, in a small clearing where no ordinary plane could have been put down.

For directing traffic from the air, and in fact for many other police activities, two-way radio communication, which has been developed to a highly practical point, lends invaluable aid to the flying policeman.



An automobile crippled by machine-gun fire from the air

OUR POINT OF VIEW

Our Safe Ships

"WHAT of the safeguards and protective devices on American ships?" asked a reader. "You have often described in your pages the design and engineering features, the service and appointments of the newer ships of our merchant marine, but are they safe?"

We had our own ideas about this question but to make doubly sure we visited at her Hudson River berth the liner *Manhattan* which, as we have previously explained, will stand comparison with any liner afloat, except in size and speed. Our inspection carried us to the bridge and then throughout the ship to see what precautions had been taken to prevent or limit the loss of life in case of fire or shipwreck.

Ours was no superficial examination. On the contrary, a fire drill was arranged for our benefit; a boat drill was signaled, and all life boats on the port side lowered with ease; bulkheads throughout the ship were closed in 37 seconds; crew members at fire stations were examined as to their knowledge of their duties and found to be equal to any emergency; fire alarms and smoke indicators (locaters) were operated on the bridge; many fire doors were closed; inflammability of cabin walls was noted; and instruments for precision navigation on the bridge were called to our attention.

The *Manhattan* is equipped with 20 metal life boats and 2 wooden motor boats with a total capacity of 1724 persons. These, in launching, slide gracefully outboard down the inclined Welin-Maclachlin davits under electrical motor control. A plentiful supply of life preservers; 142 fire hydrants; over a mile and a quarter of fire hose; and fire buckets, axes, and several kinds of fire extinguishers are all ready for instant use and are inspected at regular intervals. In spite of the fact that cabin walls are of a fireproof material, ceilings everywhere are studded with fire alarm devices in which, as in sprinkler heads, a fusible link melts with heat and rings an indicating alarm on the bridge. Besides the most modern steering machines and compasses, bulkhead door control, fire location indicator, smoke indicator, Fessenden fathometer or sonic depth finder found on the bridge of the *Manhattan*, it is understood that the operators of the United States Lines are now working on a new development, explained to us in confidence, which will assure safer navigation in dense fogs than has ever before been possible.

It is to be concluded that the *Manhattan* and her sister ship *Washington* are as safe as, if not safer than, any ship on the Atlantic today.

Death Drivers

IN a community in New Jersey where approximately 5000 motor cars are registered, the opportunity was recently offered to drivers and owners to have their cars inspected for proper operation of brakes, steering gear, lights, and other important units. Despite the fact that this inspection was offered free of charge and with no strings attached, less than half of the car owners in the area availed themselves of the opportunity. Place this example of human inertia beside the frequent reports of death and injuries from motor car accidents and a striking moral will at once be seen.

Why should a man who drives a motor car with defective brakes be considered any less a criminal than he who slips a gun into his pocket and goes forth on murder bent? The automobile driver is, if anything, more to be censured because it is usually the innocent who suffer as the result of his carelessness. The driver who approaches you along a narrow road with lights that glare and blind you is surely as guilty of placing your person in danger as if he deliberately put poison in your food.

How can these death drivers who endanger the lives and limbs of the innocent, be curbed? If only the fact could be driven home that they are, beyond a shadow of a doubt, criminally responsible when an accident is caused by their lack of care for their cars or by their own lack of regard for the rules of the road, a long step would have been taken toward reducing motor vehicle accidents. Opportunities for free inspections, such as mentioned above, will help. More rigid enforcement of sane traffic laws, with severe penalties upon conviction of violators, will make our highways safer for the thinking and careful driver.

The motor car is a highly developed and efficient machine, but it lacks a brain whereby it can care for itself. It is up to the driver to supply that brain, and to keep in mind at all times when he is behind the wheel that he must have entire control of his vehicle; otherwise it becomes a potential death-dealing device which may strike at the most unexpected moment.

For Food Faddists

WE wonder what the next dietary fad will be.

A few years ago the public had become calory conscious. Knowledge of the energy content of various foods had reached the masses and some, hoping to "balance their diet," had discovered a new indoor sport—counting calories. One woman of our acquaintance weighed her growing daughter's food and allowed the child just the amounts suggested in a book. The child grew up normally but what the mother did not know about was the gross tonnage of excess calories surreptitiously consumed in the house of a neighbor who believed that Nature—one's appetite—tells us, perhaps more scientifically than anything, how many calories we need. The book was scientific but the child was hungry most of the time.

Then came the vitamins. "Ha," said the food faddists, "Here is something new and interesting—a new game to play." During the past few years we have all become vitamin conscious—we have had to. To escape vitamin-consciousness today one would be forced to escape to a desert isle. If we do not read about vitamins we hear about them from our loving friends. "Eat this because it contains vitamin A; that for vitamin B . . . ." and so on. New vitamins discovered from time to time incite faddists to write inquiries to scientific journals: "What must I eat to get the newest vitamin?" The answer is, for the average, normal, well, adult human being, eat a good all-around diet with fruit and vegetables, and forget that you have ever heard the word vitamin. Eat what and when you feel like eating—Nature will tell you both.

Is it more than a coincidence that the too diet-conscious may usually be found in the column of the sickly, and the natural eaters in the column of the hale and hearty? Man's internal organs do not need supervision; they ran for millions of years before dietetics was discovered and we seem to be here—evidence that Nature knows her stuff.

There are exceptions: See that babies and children get enough of the right vitamins, though without making a fetish of it, and if you are organically sick see a doctor.

ICE CREAM BY THE MILE

A Successful Inventor Tells How He Commercialized His New Process For Manufacturing This Frozen Delicacy

By MILTON WRIGHT

THEY are making ice cream by the mile now instead of by the gallon. Revolutionary changes have made an exact science of the manufacture of America's favorite dessert, instead of merely an art with all the vagaries to which every art is subject.

Until this year, the up-to-the-minute freezers in the great ice cream factories of the country have consisted of cumbersome freezing cylinders with elaborate arrays of hoppers, spigots, heavy frost-coated pipes and containers to catch soupy ice cream before it spilled.

Clarence W. Vogt

But no more. A new method already has been installed in a few large cities, and so well does it operate and so popular is its product that large manufacturers in Detroit and New York have made it standard practice.

By this new process, the "mix" is pumped into one end of the machinery and from the other end are delivered cartons of paper-wrapped ice cream cylinders, each about two inches long and two inches in diameter—larger than the most generous portion of ice cream that goes with a soda. Somewhere about the middle of the machinery will be found a continuous tube of hard cream passing along an endless belt, for all the world like a never-ending stream of tooth paste being squeezed out of a giant tube.

ALL this is the invention of Clarence W. Vogt, of Louisville, Kentucky, an engineer who, it is said, will go down in the history of ice cream manufacture as the third and last of the great developers of the industry. The first of these was Jacob Fussell, Baltimore milk dealer, who became the first ice cream wholesaler when, in 1851, he froze the surplus cream from his dairy herds in York County, Pennsylvania, and then abandoned his large and profitable milk business to build up the still larger and more profitable ice cream business.

The second long step forward was taken in 1902, when Harvey Miller invented his brine freezer, and thus made possible the factory methods of ice cream manufacture which have prevailed up to now. Miller is said to have been the first to establish the value of mixing air with the freezing cream.

Now comes Clarence Vogt with his system that speeds up manufacture, makes it a continuous process, and turns out for the first time a product which is wholly uniform. Already he has approximately 60 patents and applications for patents covering about a hundred inventions on his machines and methods.

"Why didn't they make ice cream by a continuous process before?" we asked Mr. Vogt after we had looked at some of the new ice cream machinery in the plant of the Reid Ice Cream Company in Brooklyn. "Didn't anybody ever think of it?"

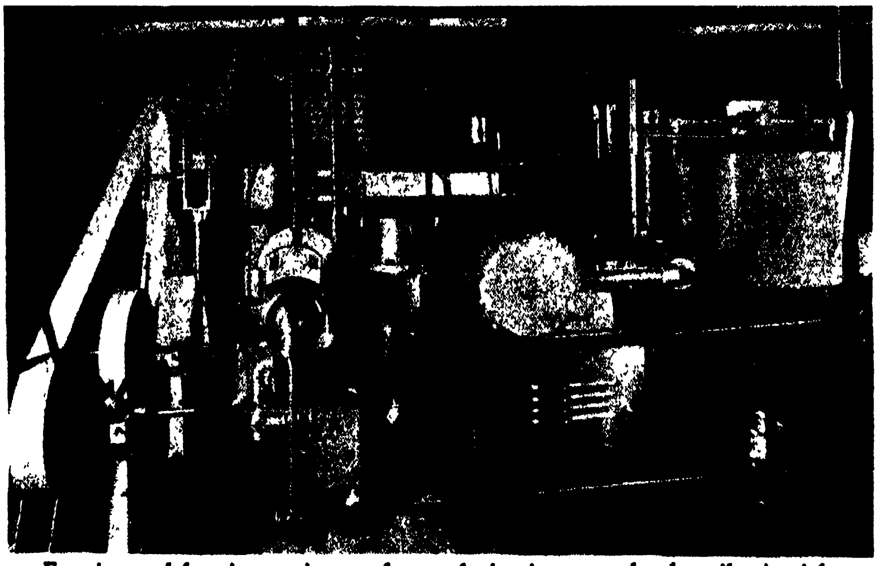
"Yes, they thought of it," he replied, "but I guess it looked too formidable. They weren't able to make the cream stiff in order to get the real benefit out of it, nor to control the 'over-run.'

"This over-run is determined by the amount of air that is put into the ice cream. It is the increase in the volume of the ice cream you take out of the freezer over the amount of the mix that you put in. In an old-type freezer the dasher mixes the air with the ice cream. Usually the ice cream in the bottom of the freezer is too heavy and that in the upper part is too light or too fluffy.

"YOU could, of course, freeze ice cream without putting any air into it, but nobody would want it. It would be bitterly cold in the mouth, heavy and soggy in body, coarse in texture and unpalatable. Too much air, on the other hand, makes it frothy and snowy.

"Injecting the proper amount of air always has been a big problem in ice cream freezing. That is why it has had to be frozen in batches—and the batches have been by no means satisfactory. With the old-type or batch freezers you get an uneven mixture, with large and weak air cells in the ice cream. That means poor body, and eventually, before the ice cream has been sold, poor texture as well.

"The new principle is simplicity itself, once you have the clue—which is merely metering the ingredients. The 'instant freezer' I have devised propels the mix and air in controlled proportions through the freezing chamber and

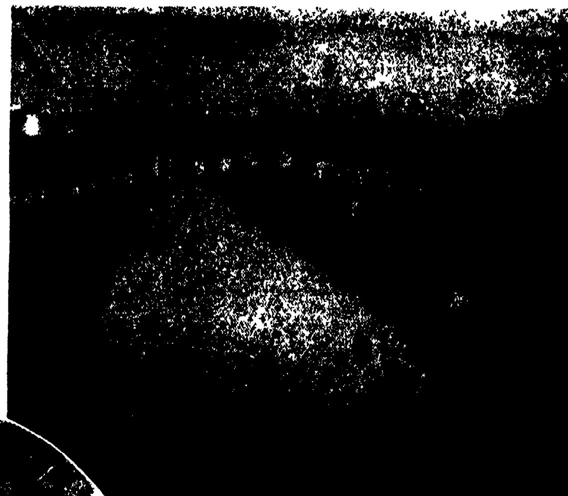


Freezing and forming equipment for producing ice cream by the mile. At right is mix tank, pump in center with freezer behind it, and paper feed at left

thus controls the over-run. It also produces a stiffness in the ice cream far greater than you can get with a batch freezer.

"We have a high-pressure proportioning pump of unusual accuracy. First, the air is introduced in measured amounts, then the mix enters, also in definite measured amounts. The pump is of a design which eliminates troubles from re-expansion, because the mix seals the air and there is no re-expansion."

So much for the inventor's explanation of his process which is enthusing the manufacturers. The product is what will determine the success of the ice cream made by the mile. The original ingredients are exactly the same as they were for the old method, but the finished ice cream is found to be superior. It is uniform in texture and it "stands up better." Suppose ice cream made the old way becomes a bit soft in the container behind the soda fountain; it gets flaky and icy and it loses volume. With ice cream made Vogt's way, however, it always keeps the same smoothness and the same volume. The explanation is that the air is in finer globules—really amounting to an air emulsion—and it stays that way because these fine globules are strong enough to keep the crystals apart.



Right: The stick cutter end of the hardening conveyor. Fourteen-foot bars of ice cream in a temperature of 35 degrees below zero are cut by knives

Circle: The new ice cream as served. _Below:_ Final cutting and packaging equipment with the final slicing machine in center

Along with the new way of making ice cream goes a new way of serving it. You sit up at the soda fountain and give your order. The clerk has no scoop; he merely reaches into his large container, lifts up a cylinder of ice cream by two bits of paper rolled around it, drops it into the glass, and there you are. Quicker, easier, more sanitary.

And is the ice cream made the new way popular? Well, a large factory in Brooklyn is working 24 hours a day in a vain effort to keep up with the demand in the metropolitan district. A factory in Detroit is turning out several miles of it every day—and only one mile cut up into pieces two inches long makes a lot of servings.

That this development should be made by Clarence Vogt is only logical. He was brought up in the refrigeration business, his father and his uncle being among the pioneers. He studied refrigeration at Cornell and abroad. In the War he won a captain's commission largely as a result of his inventions, but these had to do with explosives.

For nearly a decade he has been a force to be reckoned with in the ice cream industry. Among other things, he completely mechanized the manufacture of ice cream for chocolate-coated ice cream pies. When he organized the Vogt Instant Freezer Company, the 250,000 dollars of capital stock was all subscribed within a week.

Best of all, he and his associates are receiving all the profits from his ice cream inventions to which they feel they are entitled—and they are plenty.

"How have you managed to keep your ideas from being pirated?" we asked him.

"Being careful is what did it," was his reply. "When I realized that I had discovered a way to make ice cream better than it was being made, and to make it in one fiftieth of the time it was taking by other means, I was just enough of an egotist to believe that this discovery could be exploited best by our own group. There has been a common belief, you know, that inventors are the natural prey of more clever people who rob them and then insult them. I have always had a desire to disprove that.

"As H. G. Wells says in his 'Outline of History': 'What community of human beings has ever yet preferred creation to conspiracy? They receive new legacies like ill-bred heirs.' I was determined that if my ideas of ice cream manufacture were to be developed properly, along both scientific and commercial lines, we must see to it that the development was in our own hands.

"I am a regular 'record hound' and I don't believe in Santa Claus. Of course, I take steps to protect all my important inventions by patents, but I go further than that. Before I show a manufacturer a new process in its early stages I get him to agree that as soon as he has seen the invention he will sign a paper stating that, so far as he knows, the invention is new and original, or else stating where he has seen it before. Such a document I call an 'admission of novelty,' and it has saved me a lot of trouble. If more inventors and their backers would take precautions against what might happen, they would have less grief and more money."

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The second part of the article on food adulterations and spoilage (see page 26 of this issue), will be presented in February. Here the amateur microscopist will find further information about materials that are sometimes used to adulterate the foods he eats, and how he may detect them with the aid of his microscope.—The Editor.

Some Astronomical Surprises

The Riddle of the Coronal Lines—The Last Outstanding Puzzle in Astrophysics

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
President of the American Association for the Advancement of Science

THE unexpected still happens—in the skies as well as in human affairs. On October 9, American observatories received from the central office for astronomical telegrams at Harvard the message, "Belgium and Poland report great meteoric shower in progress." Wherever the skies were clear they were assiduously watched, but before the news had reached our side of the world the display was over. Later and fuller messages show that, on this night at least, we were living in the wrong place. All over Europe, from Russia to Spain, a magnificent shower was observed. Gerasimovic at Poulkovo reports a rate of more than a hundred per minute, Witkowski at Poznan a maximum rate of ten per second, some with brightness of the zero magnitude—equal to Vega or Arcturus.

This is the finest meteoric display since the great fall of Leonids in 1866, if not the greater shower of 1833. As in all similar cases, the meteors moved in parallel lines, and so appeared to radiate from a definite point in the heavens—this time in the head of the constellation Draco, not far from the pole of the ecliptic. The great swarm appeared therefore to be moving almost at right angles to the plane of the earth's orbit; but when allowance is made for the earth's motion it is evident that they must have been going forward around the sun, as well as downward across this plane, and so moving in a "direct" orbit with a moderate inclination.

METEOR swarms of this sort are always associated with comets, and the body responsible in this case was at once identified as the periodic comet discovered by Giacobini in 1900, and independently at a later return by Zinner. This has a period of 6.60 years, and a perihelion distance almost exactly equal to the radius of the earth's orbit. The orbit is inclined a little over 30 degrees to that of the earth, and crosses its plane in a downward direction in longitude 16°02′. At this point the comet's orbit is only 400,000 miles outside the earth's. The earth reached the place where the orbits are nearest at 8 P.M. Greenwich time on the evening of October 9, exactly the hour of the meteor shower. The computed radiant from which the meteors following the comet's path should diverge also agrees with observation, so that there can be no possible doubt of the connection.

The comet was observed this year as a very faint object, and came to perihelion on July 15, reaching the point of close approach six days later. At the time of the meteor shower it had passed far beyond, and was nearly 150 million miles away. The swarm of tiny particles which follow behind it and give rise to the shower must therefore trail a long distance. It seems probable that the recent display arose from an encounter with a denser cluster of meteoric particles in this long procession, for the main part of it lasted only about two hours, during which the motion of the meteors, relative to the earth, was only about 75,000 miles.

At the next return of the comet, early in 1940, the earth will be far away on the opposite side of its orbit, but in 1946 there should be a really close approach of the two bodies and a remarkable display may be visible—unless perturbations of the comet's orbit shift it away and spoil the show, as they did for the Leonids in 1900.

ANOTHER surprise came when Mr. Peltier, an amateur astronomer of Delphos, Ohio, found that the variable star R S Ophiuchi which he had kept under watch for years had suddenly blazed up 200 times as bright as it had been for decades. This interesting object was first detected by Mrs. Fleming at Harvard, in 1901, by its peculiar spectrum. The photographic records of the great Harvard collection show that the star had been faint (about the eleventh magnitude) from 1888 to June, 1898, when it was found to be of magnitude 7.7, about 20 times as bright as it was a month before, when the last preceding plate of the field was taken. It may have been brighter in the interim—anyway it faded rapidly and, after a smaller flare-up in 1900, returned to its original brightness, which it maintained with small and irregular fluctuations till last August, when Mr. Peltier found it of magnitude 6.5 on the 15th. An Italian observer, Signor Loreta of Bologna, observed it of the fourth magnitude on the 11th—but unfortunately his discovery was not broadcast by telegraph. Since then it has quickly faded, and it is now below the 10th magnitude.

Such a rapid outburst and steady fall suggest a nova, and the character of the star is assured by spectroscopic observations which show a bright line spectrum of the usual sort, except that the width of the bands is much smaller than for most novae— indicating that the velocity with which the gaseous shell was ejected from the star is unusually small. Plates taken at Harvard a generation ago showed a very similar spectrum during the earlier outburst, so that we have here a second example of a recurrent nova, the first being T Pyxidis which rose from the 14th magnitude above the 8th, in 1890, 1902 and 1920.

During the present outburst the evolution of the spectrum at first followed familiar lines, with bright lines of hydrogen, helium, and ionized metals, followed by the appearances of the nebular lines. But at the beginning of the present month came the real surprise. Adams and Joy, observing at Mount Wilson, found a strong, new bright line at wavelength 5303, while the red line of ionized silicon at 6371 had shifted to 6376—that is, had faded away and been replaced by another line. Now these two wavelengths are very familiar to solar observers—the lines in these positions are no other than the strongest in the spectrum of the sun's corona. They are still visible, and probably other coronal lines will be found to accompany them. The star is fading rapidly and, what is worse, getting into the evening twilight, so that within a few weeks observation will have to be suspended till February or March. It is fortunate indeed that it was not lost in the sunlight a month earlier.

HERE is something wholly without precedent. The coronal lines were previously known only in the spectrum of the sun's outer envelope. Even there they are so faint that only the brilliant experimental ingenuity of Lyot has made it possible to observe them at all except during a total eclipse. But in R S Ophiuchi they stand out strongly in the integrated spectrum of the star's light and must be many thousands of times brighter than they have ever been seen before. The last of the single instances in spectroscopy thus disappear.

There is nothing left that is confined to a single source and the conviction is reinforced that the coronal lines, whatever their origin, do not come from an unknown gas but from some known element shining under unknown conditions.

Whether the study of this nova may give further clues as to the puzzle—the last outstanding one in astrophysics—remains to be seen. Meanwhile a promising tentative interpretation of some of the coronal lines comes from the same investigators who have recently identified neon in the nebulae—Menzel and Boyce. They find that the difference in the wave numbers of the coronal lines at 6374 in the red and 3454 in the ultraviolet agrees within the error of present data with the separation of the known energy levels in the neutral oxygen atoms. That is, the two lines could be produced by transition from a previously unknown and very highly excited state of the oxygen atoms to these two known states. A third line at 3987 is in about the right place for a transition from a still higher level bearing the familiar series relation to the one first suggested. The green line 5303, though strongest of all, remains unexplained.

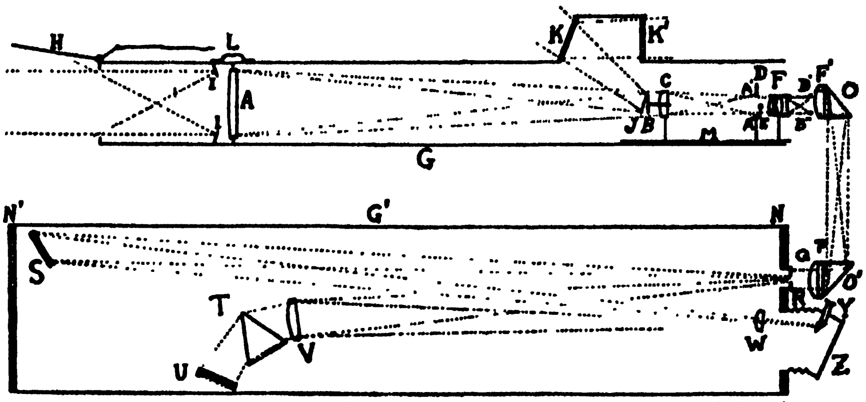
IN favor of this interpretation, first and foremost is the fact that Hopfield, some years ago, actually found the red line 6374 in the spectrum of oxygen in a vacuum tube. The agreement in wavelength of the laboratory and the coronal lines is so close as to leave little doubt that the latter is really due to oxygen. Further favorable evidence is that these three lines are strengthened in the same portion of the corona, while the green line behaves differently. On the other hand, as Menzel and Boyce point out, other oxygen lines which might be expected to appear in the corona do not. Whether this is due to peculiar conditions of excitation, time will tell.

Meanwhile, laboratory workers will doubtless grow busy with their discharge tubes, subjecting oxygen to the most varied conditions of electrical excitation that their ingenuity can devise, and photographing the spectra. Some well reasoned plan, or even some lucky fluke, may solve the problem. Professor R. W. Wood, after his notable success in producing in the laboratory about twice as many lines of the hydrogen series as had ever been secured before, said to the writer, "I supposed that everything possible had already been tried with a hydrogen Geissler tube. But apparently no one had ever thought before of making a tube 12 feet long." The long tube did it!

Whether in one way or another, there is now better hope than ever that the riddle of the coronal lines may soon be fully solved and the last important uncertainty in astrophysics be dispelled. —*Mt. Wilson Observatory*, Oct. 30, 1933.

The Lyot Coronograph

IN his article in the December, 1932 number, Professor Russell told of the discovery of a method for photographing the sun's corona without an eclipse, accomplished by the French astronomer Lyot, and in the accompanying article he refers again to the same astronomer and method. This method has now been described in detail by Monsieur Lyot, in the September, 1933 number of the *Journal of the Royal Astronomical Society of Canada* (198 College Street, Toronto) from which the accompanying illustration is reproduced and the following abstract is made:



The Lyot coronograph and attached spectograph for viewing and studying the sun

Theoretically, says M. Lyot, the corona should be observable in daylight, but the solar image produced by the objective or mirror of a telescope is surrounded by a halo of light which is a thousand times brighter than the corona. The cause of this halo is diffusion (diffraction) of the sun's light by dust and water particles in our atmosphere, also by the instrument itself —the latter due to diffraction from the edge of the aperture, from tiny flaws in the glass, air bubbles, minute scratches, and other sources of parasitic light, any one of which would hide the faint corona entirely.

The coronograph was therefore designed to eliminate these parasitic sources of light. In the sketch the upper portion is the mounting of the coronograph and the lower part is the spectograph. *A* is a plano-convex lens of 13 centimeters aperture and 3.15 meters focal length, made of finest optical glass, flawless and polished with the utmost care. This forms an image of the sun on disk *B* of blackened brass, which extends beyond the edge of the sun by 15 seconds of arc. Field lens *C* produces an image of lens *A* at *A'A''*, on diaphragm *D*, whose edge is occupied by a tiny screen *E*. "The outer portion of the diaphragm," says M. Lyot, "stops the diffracted light from the borders of the first lens. The little screen *E* stops the light of the solar image formed by reflections between the two surfaces of the lens *A*. Behind the diaphragm and the screen, sheltered from diffuse light, an objective *F*, highly corrected, forms at *B'B''* an achromatic image of the corona. These parts of the apparatus are mounted on plate *M*, which slides in grooves in order to permit the placing of any point of the solar image on the screen."

G is a wooden tube 5 meters long, the inside walls coated with heavy oil. *H* is a flap to close the tube. *I* is a concave diaphragm, and *J* is a disk which disposes of the radiation not used, in order to avoid air currents in the tube. Light from *J* emerges at windows *K* and *K'*.

Equipped with an eyepiece and red screen, this apparatus showed many solar prominences, and photographs were taken using panchromatic plates and a red filter.

The apparatus in the lower portion of the sketch is the spectrograph. The achromatic objective *F* of the upper instrument was removed and replaced by simple lens *F'*, which forms an image of the corona on slit *R*, the light first passing through two total reflection prisms *O* and *O'*, colored filter *P* which isolates the spectral region to be studied, and field lens *Q* which forms the image of the diaphragm *D* either on grating *S* or prism *T*, by orienting *Q* as desired. *W* is a converging lens, *Y* is a little microscope for observing and correcting for flexures of the tube, and *Z* is the plate. The other spectrograph has prism *T*. This is traversed twice by the light, which is reflected by flat mirror *U*. *V* is a simple lens.

Not every minor detail described by M. Lyot has been covered in the above abstract, and no constructor should attempt to build a Lyot coronograph without more precise details. The Lyot apparatus has also been used at Mount Wilson Observatory, and was briefly described in the *Publications of the Astronomical Society of the Pacific*, August, 1933, by Dr. Edison Pettit and Prof. Frederick Slocum, who have employed it.—*A. G. I.*

THERE IS RESEARCH . . . . AND RESEARCH

How Much Real Scientific Research Lies Behind Some of the Patent Medicines, Cures, and Medicaments Sold to the Less Intelligent Fraction of the Public? Who Should Conduct Such Research?

By T. SWANN HARDING

RESEARCH is a high and mighty name. There is a sort of magic and a kind of majesty about it. We conjure up thoughts of long-haired, horse-faced men sitting solemnly in impressive laboratories amid complex apparatus making Nature, like a blushing school girl, tell her secrets. We think of these men as adding to the sum total of human knowledge—as engaging in activities that are of immense social value. They are the servants of all mankind. But there is research . . . and research. There is research "The Business Builder" as well as research the servant of man.

Not long ago, a former carpenter who became an opulent cancer-cure quack was prosecuted and actually sentenced for his crimes. His cancer cure was, as a whole, commonplace. It consisted of using corrosive substances to eat away flesh, and following up with healing ointments and applications. The interesting thing is that two of his remedies consisted largely of "pyroligneous" substances distilled from peat. This distillation was performed by the use of a very intricate and impressive apparatus. This apparatus, as well as the distillate, as far as its assumed healing properties were concerned, had been patented. The whole business was not only foolishly unscientific; the very existence of the cure and its exploitation constituted a social and hygienic menace of the first order.

SUCH quacks are just as surely public enemies as gangsters and unscrupulous bankers. Yet it took some knowledge of science and it required some research to produce that elaborate apparatus and the subsequent pyroligneous remedies. That constitutes what I once called "The Degradation of Science," in the title of a book I prepared on the subject. Yet we spend many dollars today on what might be called anti-social research for every single dollar we so unwillingly expend upon fundamental research into basic problems of nature, which research is truly scientific in character.

In that period to which we referred as "prosperity," I happened to be associated with a manufacturer of pharmaceutical and similar products. The plant went in heavily for what we laughingly called "research" and "laboratory control." And this, when you truly understand it, is a very beautiful and impressive thing!

Thus, one day, the Chief Chemist suddenly and happily coined a very beautiful and musical word. It was a magical word, like Mesopotamia. He at once ran to the President, who sat in august majesty, surrounded by tens of thousands of dollars' worth of the finest period furniture. Thereupon the General Manager and the Advertising Manager were called and the four of them soon sat around a mahogany table in a room that resembled the private chapel of a mediaeval monarch (with a somewhat perverted idea of the Deity's taste in decorative art, I hope). They began repeating the magical word and it intoxicated them. An office secretary, who swore me to secrecy, declared it was very entertaining to hear them.

THEN, after they had savored this pleasure to the full extent of its very obvious limitations, they told the Chief Chemist he must find a product which would be fit to bear the name. Then he should consult with their Director of Medical Research who should find a disease for which the product with the magical name might be recommended. Then, while a few laboratory experiments were undertaken with animals, they should all again consult the Advertising Manager, who would thereupon burst into lyrical strophes; after which they could break into a Greek choral dance celebrating the curative properties of the product which had been fitted to the magical name.

Thereupon the product would go upon the market sans adequate clinical tests. Thereafter profits would roll in. Then imitators would spring into the market. The druggists and doctors would be very much puzzled by the clamant claims made by each producer for his specific remedy. Ultimately the general public would be out considerable sums of money, since everybody technically equipped to know anything about the matter would at once agree that the stuff had no real therapeutic value anyway.

All this sounds chimerical. It really is not. It is all too closely typical of the *modus operandi* of some pharmaceutical houses when putting their new orthodox remedies on the market.

You do not have to take my word for this. The physicians and pharmaceutical chemists who examine and certify "New and Nonofficial Remedies" for the American Medical Association know this is true and have said so in print. The market is full of medicaments put out by so-called reputable houses after just such inadequate travesties of "research" as this. Without moving from my desk I could show you an apparently reputable medical journal which contains advertisements of at least 20 therapeutic products that are no more useful than the one I have just described. Nor, indeed, are they of any more value than a hundred proprietary or patented remedies which our drug stores constantly sell us for our neurotic self-medication.

In times of prosperity perhaps that sort of thing is all right. But I wonder just how much of such flagrant economic waste and abuse of research we should tolerate in such periods as the present. Secondly, since this sort of exploitation has uniformly rested upon the casual, almost empirical sort of "research" carried out by private industry, or else has represented an application (or a mis-application) of fundamental scientific knowledge discovered at public expense in federal or state laboratories, just how far should we continue to permit this sort of insanity? For it is insane to abuse research, to degrade science, to make extravagant advertising claims, to compete for trade, and to undertake the expenses of production—all to perform what is economically and scientifically an anti-social act.

MY laboratory experience has been considerable. In the last depression before this I found myself in the research department of a firm that advertised its rigid laboratory control. A

certain product made by this firm suddenly and inexplicably began to have an evil odor. The research staff was at once ordered to devise some sort of spray which could be used on the product in the course of manufacture to make it smell better when finished. There was no attempt whatever to discover the real reason for the evil odor. A spray of the type desired was devised, and satisfaction reigned.

Again, certain animal glands that were used for making medicines for which were claimed almost magical curative powers—though the *Journal of the American Medical Association* constantly warns against such faith—were purchased from South America. They often spoiled en route and smelled so badly that one could not get near them when they arrived. But they were very cheap, much cheaper than domestic glands. So they were at once dumped into ice water. Then some workmen would creep up on them and rush them through grinders; finally they were dropped as quickly as possible into baths of acetone. After several subsequent acetone baths, careful drying, and some more grinding, this stuff went into capsules.

IN my naive way I thought trouble brewed here. I said: If you send out a certain product called So-and-so, which demonstrably is not So-and-so at all; or if you send out a certain antiseptic which is not antiseptic; or a product containing silver which contains only half as much silver as it should; or perhaps twice as much alkali as it should—you will surely get into trouble. But I was told they would get into no trouble at all. Clinics, hospital laboratories, physicians, and the public rarely complained about any such things. They might go raging mad over an adverse decision by a baseball umpire but certainly not about an inferior gland remedy. If complaints were made, the company had its research department, did it not? And its control laboratory could actually be shown—in fact it always was displayed pictorially in advertising. It was just a slip. They could replace the bad lot with better products—which often came out of the same lot.

Almost the last efficient and economical service performed for a waiting public by this firm before I left it was this: At that time the field for certain liquid preparations seemed very profitable. Most of these products were very poor in quality. Indeed the majority of them were useless. My firm decided, however, that it might pay to enter this crowded, competitive field, so "research" was undertaken. A bacteriologist and a chemist went rapidly through several formula books. They finally apprehended a very common formula that looked easy to prepare. Immediately the Advertising Manager was sent for. He danced a polka, and ecstatic prophylactic lyrics gushed forth from him like radium emanations.

The Government, maintaining disinterested bureaus, is the logical source of unbiassed findings from research on products used by the people. Here are some Government scientists discussing the results of potato breeding experiment work. They are not imaginary "long-haired" scientists with whiskers, but plain men

Although it had long reposed sepulchrally in formula books, this formula now suddenly became the most matchless, the most glorious, the most powerful, and the most health-producing of all such nostrums. Bottling apparatus was purchased. Laborers were hired. Printed matter appeared in abundance. Raw materials flowed in. Production got under way. It was necessary to get the stuff on the market in almost frantic haste in order to clean up before the racket became unfashionable and was outmoded. Shipments were being sent out within a month after the initial "research" was undertaken, all guaranteed by "our watchful laboratory control."

The only trouble was that the new product proved too enthusiastic. It wanted to get at work so badly that it couldn't wait for consumers to open the bottles. It burst out of them and gushed all over the place. In more prosaic terms, a chemical reaction that might easily have been foreseen inevitably took place in such a mixture and the bottles were irrevocably blown to bits two or three weeks after shipment. Nobody stopped to think about this unavoidable chemical reaction, for the mad pursuit of profit prevented rational thinking.

There was nothing but a loss to show for all this. Even had the product "held up" in the bottles there was no social justification for its existence. As things were, the firm charged off about 100,000 dollars as loss and tried to forget it. But do not think the loss went unpaid. Ultimate consumers cheerfully paid it, as they usually do. They paid it in the price of other products they bought from that wasteful and inefficient firm.

They did not pay painfully, as in the case of an income tax with which they purchase government research that returns 5000 percent dividends to the public on the relatively small sum (20,000,000 dollars or so) annually invested therein. They paid painlessly in the form of 25 cents additional for some attractively bottled or packaged product which the firm sold for one dollar and which, container and all, it possibly cost eight cents to produce. Why did they pay the very exorbitant one dollar instead of the already exorbitant 75 cents? Because the wasteful and inefficient methods of such firms make it habitually necessary for them to charge excessively for their products, in order to cover unnecessary losses, wild extravagances, complete failures, and flagrant plant inefficiency.

IN last analysis the public pays the cost of all research. It pays the salaries of the technicians in private industry, just as it pays those of technicians employed by the Government. It pays for the plants and equipment and "research" of private firms, just as surely as it pays for that in the Government. If the public is going to buy "research," why is it not wise for it to purchase from the Government, where each dollar so expended brings 500 dollars in social profit? Why? Because such research is planned rationally. Because it concerns socially

and economically beneficial and justifiable projects and processes. Finally, because trained scientific specialists, not salesmen and business promoters, direct and control Government scientific bureaus.

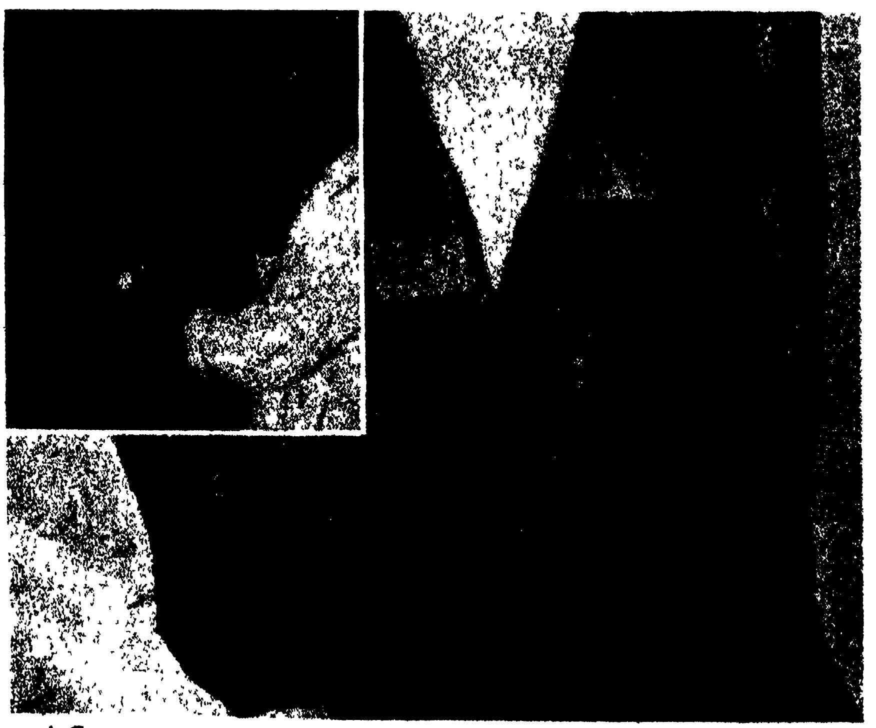
IN 1843 Peter Dunn, a milkman near South Ferry, New York, bought a ship cow from the captain of an English vessel. It had contagious pleuropneumonia, an insidious and destructive cattle disease. It infected Dunn's herd and the infection soon spread to other nearby herds. The disease went on into New Jersey and, in 1859, broke out in Massachusetts, where it was introduced by four cows imported from Holland. The legislature of Massachusetts passed an act appointing a commission to deal with the matter. Quarantine, slaughter, and interment of diseased cattle followed, with cleansing and disinfection of premises. Nevertheless the disease soon reached five other nearby states and the District of Columbia.

National authorities and livestock men generally were indifferent to this disease until 1879. But when the British Privy Council, in an order dated February 6, 1879, decreed that all cattle imported from America must be slaughtered on the docks within a limited time, and the price of American steers dropped 10 dollars below that paid for similar Canadian animals, it was seen that this country faced an annual loss of a million dollars. Something had to be done. State action had failed to stamp out the disease; it was ineffective because close co-operation between the states could not be secured. Some states would assert they were free from the disease when they were not; one state would be blocked by the negligence of a neighboring state, and so on.

Before the National Government could act laws had to be passed, funds provided, and an organization created. In those days it was not considered a proper government function to deal federally with the production and shipment of livestock. States rights intervened. Congress was besought not to add new regiments to Federal job-holders. But fundamental research must be carried out, and its results applied on a national scale. Though the severity of the disease was questioned and the veterinarians were ridiculed, a bill establishing the United States Bureau of Animal Industry, and playfully called "The Horse Doctor Bill", was passed. That was in May, 1884. This Bureau undertook scientific research of basic biological, social, and economic significance.

Pleuro-pneumonia was stamped out in five years—a world record in the control of this disease, an immense boon to the livestock industry, and a striking demonstration of the effectiveness of Federal research in handling livestock disease problems. However, from 20,000,000 to 30,000,000 hogs died annually of hog cholera. Contagious abortion and tuberculosis afflicted cattle. There were foot-and-mouth disease, anthrax, black leg, tick fever, and other diseases. So the activities of the Bureau were extended and it became the first scientific institution in the world to demonstrate that insects could act as intermediate hosts for disease germs, work which later resulted in the eradication of yellow fever from large infested areas. No case of pleuro-pneumonia in cattle has occurred in this country since March 25, 1892. The total cost of the work of eradication was 1,509,100 dollars, or less than would have been lost in two years on cattle export to Great Britain alone.

That is typical of the research the Government undertakes. It is fundamental in character and of the greatest practical social and economic value. In January, 1933, a boisterous congressman took the scientists of the Bureau of Plant Industry to task for spending 250,000 dollars on developing one potato variety. This statement was wrong, of course, for that sum financed all the experiments carried on by the Department of Agriculture over a period of 20 years during which time it sought to develop disease-resistant varieties of potatoes. Farmers were planting many potatoes and reaping few because disease destroyed so many. That was dead loss. By long and laborious breeding and plant testing a potato called the Katahdin (after the highest and most prominent mountain in Maine) was developed.



A Government employee making a tuberculin test on a cow: also the interior of a tubercular cow's carcass, showing the many nodules which are an evidence of tuberculosis. Inspectors condemn such carcasses but, up to the time of her slaughter, this cow had been used as a source of milk for someone. The owner objected strenuously to the test which revealed the presence of the disease

THIS happened to be the first of many experimental varieties released for general cultivation. It was excellent in shape and appearance, smooth in skin, bright in color, with shallow eyes, high uniformity in size and shape, and had yields equal or superior to those of established varieties. Moreover, since it resisted the plant virus disease called mild mosaic, experts estimated that it alone would soon save farmers a thousand times a quarter of a million dollars by giving good yields. This would make it less expensive all along the line and Katahdin also yields more No. 1 grade potatoes than other standard varieties.

This sort of research, as can be seen for both examples, is slow and laborious. It cannot be made to yield quick profits next week or next month. It is best undertaken in an atmosphere free from the profit motive and the commercial competitive spirit. Such research is constantly being carried on by the Government. I do not mean to imply that no socially valuable research is ever carried on by private enterprise. The scientific laboratories of General Electric alone, for example, would demonstrate the falsity of such a statement. But it will be found that the companies that do undertake research of that character are usually, to all intents and purposes, large corporations quite governmental in scope and character.

An Amateur's Dream Come True

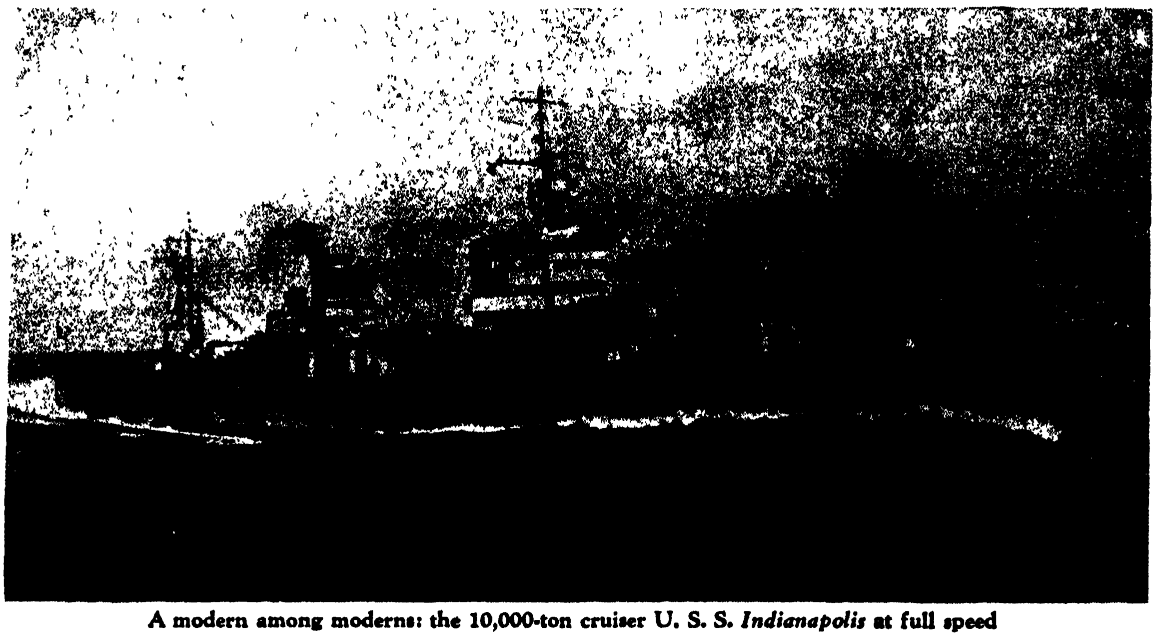
WHAT James Stokley, Director of the Fels Planetarium in Philadelphia, writing in *The Telescope*, published at Deleware, Ohio, describes as "the most interesting astronomical institution in this region" is a private observatory which represents the hobby of an amateur. "This observatory," Mr. Stokley continues, "is the property of Mr. Gustavus Wynne Cook, manufacturer and banker, and is located on the grounds of his home, Roslyn House, at Wynnewood, Pennsylvania, one of Philadelphia's most pleasant suburbs. Because of building restrictions, intended to protect the fine residences in the vicinity, the usual observatory domes could not be built, and a type of construction was adopted that is rather unusual for so large an instrument. Walking past in the daytime, a visitor might never suspect that a building resembling a small cottage contains a large reflecting telescope. But if he were to pass in the evening, he might see the roof slide back along its peak, and the skeleton tube of the instrument emerge to sweep the heavens. Entering the building--the 'Star House,' as Mr. Cook calls it - he would find a very business-like telescope, with a mounting of the open fork type, similar to that of the 60-inch at Mt. Wilson, and a main mirror of 28.5-inch aperture. The tube is of duralumin, and the polar and declination axes are mounted on roller bearings. A choice of secondary mirrors permits the use of the telescope either as a Newtonian or Cassegrain.

"Attached to the tube, and of the same focal length as the 28.5-inch mirror, is an 8-inch refractor, as well as a 6-inch finder, of shorter focus. The 8-inch objective is the work of Mr. C. A. R. Lundin, and it was formerly used in a Clark mounting, the predecessor of the reflector. All the other optical parts of the new telescope, as well as the mounting itself, are the work of Mr. J. W. Fecker of Pittsburgh.

"A full battery of accessories permits the efficient use of the telescope for virtually all phases of astronomical observation—visual, photographic, and spectroscopic."

Upper right: **Interior of Roslyn House Observatory, with the gantry roof rolled off, showing the 28½-inch reflecting telescope. It has an electric drive**

Right: **Exterior of the observatory. The gantry roof is closed. In the background is the building which houses a spectroheliscope and a solar telescope**



A modern among moderns: the 10,000-ton cruiser U. S. S. *Indianapolis* at full speed

THE DEVELOPMENT OF

THE MODERN CRUISER*

By COMMANDER HENRY E. ROSSELL (C. C.) U. S. N.

SCIENTIFIC AMERICAN is frankly proud of its naval tradition; it has, through several decades, been infinitely closer to the Navy than has any other American journal for the layman. Bearing witness to this fact are the names of many famous naval authorities who have written for our pages, perhaps the most famous of whom was our own Admiral Mahan whose writings are in the curricula of naval academies the world over.

During recent years, questions of naval limitation have so occupied the press and public mind as to exclude almost completely any studies of warship design, construction, and usefulness. The moment is propitious, therefore, as the United States begins a new naval building program, to consider seriously these vital details, so that the country may the more intelligently work out its naval destiny.

During 1934, we plan to publish a number of articles by authorities who will give these naval problems their expert, analytical attention. Commander Rossell's fine article is the beginning; others will follow as speedily as they can be prepared. All will be interesting and informative.—*The Editor*.

IN recent years the design, construction, and performance of cruisers have been of great public interest, particularly in this country. The reasons for this interest may be traced back to the early days of the World War when the exploits of a few small German cruisers thrilled belligerents and neutrals alike.

Perhaps the best known of these sea raiders was the *Emden*, a vessel of only 3500 tons displacement and armed with 10 four-inch guns. For several months after the outbreak of the war this ship roamed around the Indian Ocean and nearby waters, preying on enemy shipping. All told, she sank some 70,000 tons of British merchant ships, in addition to a French destroyer and a Russian cruiser of about her own size. During her long cruise the *Emden* was able to maintain herself by replenishing her fuel and stores from captured ships. The *Emden* met her end when she was overtaken and destroyed by a larger and more powerfully armed Australian cruiser, the *Sydney*.

The depredations of German cruisers on the commerce of the allied powers, though highly spectacular, were of small military importance. In fact they had no effect whatever on the outcome of the conflict. It was in the fleet actions of the war that the more important functions of this type of ship were demonstrated. These may be explained best, perhaps, by a consideration of the history of cruiser development.

FROM about 1890 cruiser design developed along two divergent lines. The first led to a ship with a belt of comparatively heavy armor along the water line and with guns of rather large size, in some ships as large as nine or ten inch. In addition to these primary battery guns, a number of smaller guns, three to six inch, were carried for protection against torpedo vessels. The speed was about 25 percent greater than that of contemporary battleships. Ships of this type were given the name "armored cruisers." The type was inaugurated in 1890 by the French in the *Dupuy-de-Lôme*, a ship of 6500 tons displacement and 20 knots speed. At first naval powers showed but little interest in armored cruisers. In the Russo-Japanese War they gained great prestige, however, as a result of the excellent work done by Japanese armored cruisers at the battle of Tsushima. Here they were able to keep their stations in line of battle in opposition to Russian battleships.

Subsequently, armored cruisers were built in large numbers by all of the

*Courtesy *The Tech Engineering News*

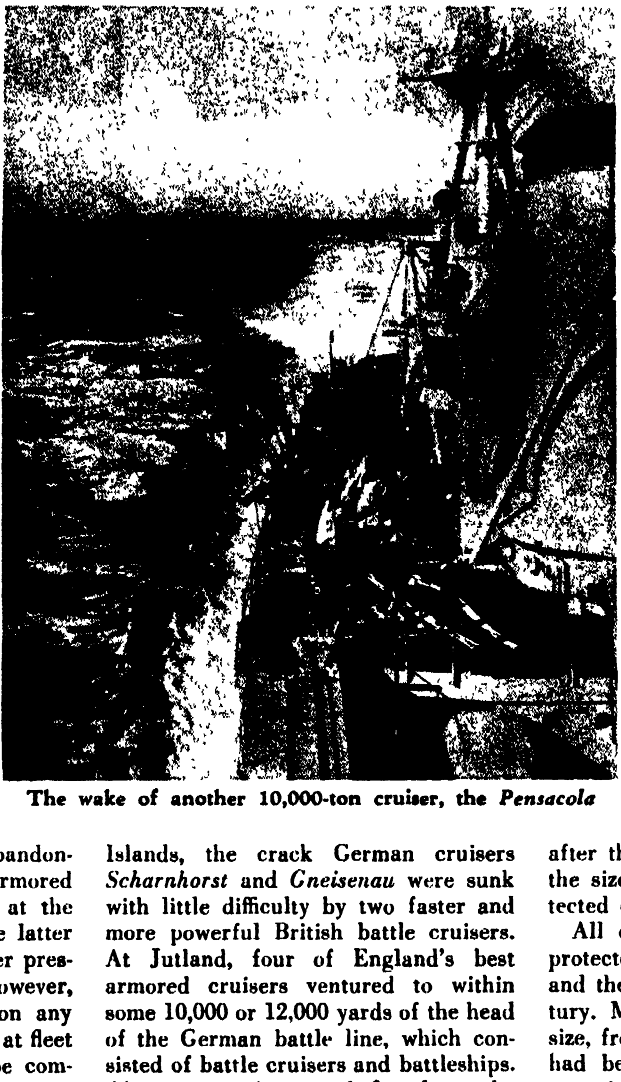
great naval powers. By 1906 such ships had reached a size of some 15,000 tons, made a speed of about 24 knots and carried guns as large as 10 inch. The armor belt was about six inches thick, and generally an armored deck was fitted to resist shell which might penetrate the belt. Armored cruisers of this period were almost as large as contemporary battleships, but they were inferior to the latter in all respects except speed.

Designers were counting, apparently, on these ships to take part in fleet actions against enemy battleships as they had done at Tsushima. Certain very important events had taken place in the meantime, however, which seem to have been overlooked by armored cruiser advocates. The penetrating power of artillery had been increased greatly without corresponding improvement in armor. Moreover, revolutionary developments were taking place in methods of control of gun fire. A third important factor was the introduction of the all-big-gun battleship, or dreadnaught, a vastly more powerful ship than its predecessors. At the same time England brought out the battle cruiser, essentially a high speed dreadnaught with slightly inferior armor protection.

The advent of the battle cruiser caused the virtual abandonment of further construction of armored cruisers after about 1908, but at the outbreak of the World War the latter type still held much of its earlier prestige. Most naval officers felt, however, that it could not be relied upon any longer for duty in the battle line at fleet actions. Its functions were to be commerce destruction and protection, scouting, patrol, and convoy duty.

THE German ship *Blücher* (1908) was among the most powerful armored cruisers ever built. She had a displacement of 15,550 tons and a speed of 25¾ knots, and carried 12 8.3-inch guns in addition to a battery of smaller guns. Her side armor had a maximum thickness of about seven inches, but her deck armor was rather light. At the battle of Dogger Bank the speed of the *Blücher* proved to be insufficient to enable her to escape the British battle cruisers. Their 13.5-inch shell penetrated her protective deck at a range of about 17,000 yards and exploded beneath it. After having been reduced to a state of helplessness by two hours of artillery bombardment, the ship was sunk by a torpedo from a British destroyer.

Other armored cruisers offered less stubborn resistance. The war was only a few weeks old when three British ships of this class, namely the *Cressy*, *Aboukir*, and *Hogue*, fell easy prey to a lone 300-ton German submarine. A few months later at the battle of Falkland Islands, the crack German cruisers *Scharnhorst* and *Gneisenau* were sunk with little difficulty by two faster and more powerful British battle cruisers. At Jutland, four of England's best armored cruisers ventured to within some 10,000 or 12,000 yards of the head of the German battle line, which consisted of battle cruisers and battleships. About two minutes of fire from the heavy German ships disposed of three of the four British cruisers. One blew up at once, another blew up during the following night, still another sank some hours later, while the fourth escaped.


The wake of another 10,000-ton cruiser, the *Pensacola*

These experiences and many similar ones led to a general lack of confidence in armored cruisers. They were too weak to fight heavy ships and too slow to avoid action against more powerful vessels. Moreover, they were not suitable for scouting duty because of their poor speed and excessive size. On patrol or convoy duty they made attractive and none too resistant targets for enemy submarines. All were agreed that armored cruisers had few merits and many shortcomings—in short, that they were obsolete. So ended one line of development which had started in 1890 with the French *Dupuy-de-Lôme*.

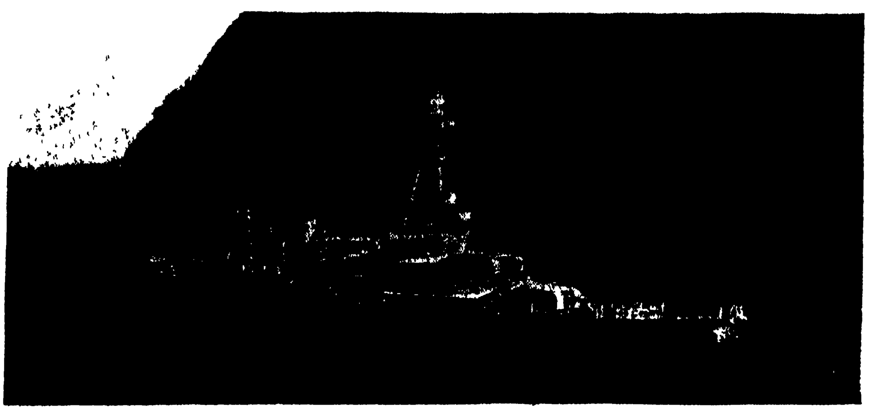
During the Nineties the British navy did not look with favor upon armored cruisers. It preferred the so-called "protected" cruisers. In these there was no side armor, in lieu of which an armored or "protective" deck was placed over the vitals or perhaps over the entire length of the ship. Ordinarily the deck was sloped down on each side so that it joined the ship's side several feet below the water line. The crown or flat portion of the deck was placed several feet above the water line so that shell holes in the side of the ship would not admit water over the entire surface of the deck. This system of protection had been introduced in 1880 in the Italian battleship *Italia*.

MANY of the British protected cruisers of the Nineties were of large size and carried relatively heavy guns. For example, the *Terrible* class (1895) was of 14,200 tons displacement and carried two 9.2-inch guns as well as a number of six-inch guns. It soon became apparent, however, that ships of such large size were not required for commerce destruction and protection. This seems to have been the primary duty for which they had been designed. Thereafter there was a gradual reduction in the size and armament of British protected cruisers.

All of the other large navies built protected cruisers during the Nineties and the early years of the present century. Most of them were of moderate size, from 2000 to 8000 tons. The ships had been designed for commerce destruction and protection, but they reflected in their widely divergent characteristics the uncertainty as to just what qualities were desirable for work of this kind. Some carried heavy guns while others were lightly armed. For example, the Japanese *Matsushima* class (4200 tons) had a single 12.6-inch gun on each ship besides smaller guns, while the Russian *Bogatyr* class (6500 tons) carried only three-inch and six-inch guns. Speeds ranged from as low as 16½ knots to 25 knots.

At the battle of Yalu in the Sino-Japanese War, ships of the *Matsushima* class were extremely inefficient. They could not make effective use of their 12.6-inch guns, for which great sacrifices in other characteristics had been made.

Among the miscellany of ships of the



The *Pensacola* in the Culebra Cut, Panama Canal

protected cruiser type, the Russian *Novik* (1900) pointed the way toward future development along rational lines. This vessel was of only 3000 tons displacement, but she made a speed of 26 knots—very high for the time. She carried six 4.7-inch guns and five above-water torpedo tubes, and had a protective deck of two-inch thickness over the vitals.

During the Russo-Japanese War protected cruisers were unable to keep position in the battle line at fleet actions, but they proved of great use in other respects. In the preliminary stages of an action they were used for scouting. During an engagement they served to give the heavy ships protection against attack by torpedo vessels. Throughout the war the cruisers were used for patrol duty and for breaking up attacks by enemy light ships. The Japanese found that cruisers were of great service in the protection of their lines of communication to Korea from the attacks of Russian cruisers. On the whole, the experiences of the war seemed to indicate that the primary functions of cruisers had to do with fleet operations and not with commerce destruction.

From 1905 to 1914, many small, fast cruisers were built, principally by the British and German navies. In these ships, speed, cruising radius, seaworthiness, and handiness were emphasized. Batteries were light, consisting of guns of from four- to six-inch caliber mounted on the deck behind light shields or entirely unprotected. In most cases side armor of two- to four-inch thickness was fitted, in addition to a light protective deck. Generally deck torpedo tubes were carried. Sizes ranged from 3000 to 6000 tons, and speeds from 23 to 29 knots. These vessels were called "light cruisers," a term which is still in use. Among the most successful of them were the ships of the British *Arethusa* class (1913). In this class, high speed—29 knots—and reasonably good offensive and defensive power were obtained on the small displacement of 3500 tons.

During the World War, the *Arethusas* did excellent work in patroling the North Sea, in scouting, and in leading destroyers in to attack. Indeed, throughout the war light cruisers of moderate size, rarely over 5500 tons, seem to have fulfilled all of their functions efficiently. In fleet actions, these vessels were of great use to both sides in ascertaining and reporting the strength and disposition of the enemy, in supporting torpedo attack, and in breaking up enemy torpedo attack. In carrying out these duties they met with surprisingly few disasters. Their protection was sufficient to enable them to engage in protracted engagements with each other. At the same time they were too small to attract the fire of enemy capital ships except on rare occasions. Even then the light cruisers were often successful in escaping by virtue of their great maneuverability, high speed, and small size.

Torpedo tubes were of little or no use to cruisers during the war. Though many torpedoes were launched, practically no hits were obtained. In fact, so far as the writer knows, the only successful torpedo attack from a cruiser during the entire war was one which sank the German cruiser *Frauenlob* during the night action after Jutland.

Normal post-war developments in cruiser design were toward greater displacements and toward slightly higher speeds. These features were incorporated in the British *Frobisher* class (9770 tons, 30 knots), British E class (7100 tons, 33 knots), and French *Daguay-Trouin* class (7880 tons, 34 knots). All except the *Daguay-Trouins* were generally similar to earlier light cruisers. The French vessels differed in that protection was very light and consisted only of a protective deck. All navies gradually adopted airplane catapults as a feature of cruiser design.

In 1922, a most disturbing factor was injected into the problem of cruiser design. This was the Washington Naval Treaty (Treaty for the Limitation of Naval Armament). The treaty set a limit of eight inches on the caliber of guns which could be carried by a ship of displacement less than 10,000 "standard" tons. Standard displacement does not include fuel oil or reserve feed water. By this measure, a 10,000-ton ship actually displaces about 11,500 tons when ready for sea.

The Treaty limitations led to the advent of an entirely new type of cruiser. Vessels of this type, which were built shortly after the signing of the Treaty, were armed with eight to ten eight-inch guns in addition to a few guns of smaller caliber. Most of them carried deck torpedo tubes and airplane catapults. Some were fitted with airplane hangars. Speeds ranged from 32½ knots on American and British vessels to 38 knots on Italian ships. All of the earlier Treaty cruisers had very light protection, in some cases insufficient to resist the attack of a destroyer's guns. In their design and construction, great effort was made to save weight in order to secure the "most ship" on the allowed weight. Costs were extremely high, because of the weight-saving policy.

WITHIN recent years there has been a strong trend in the design of Treaty cruisers toward increased protection, but even today these vessels are referred to by their critics as eggshell ships. They are styled officially as "heavy cruisers," the old name of armored cruisers being avoided.

The eggshell cruisers have met with very severe criticism abroad, especially in England. The critics claim that these ships are unnecessarily large and expensive, that they are poorly protected, and that their guns are too large. Indeed, several foreign powers have abandoned the 10,000-ton cruisers in favor of smaller vessels armed with six-inch guns.

The United States has been a staunch advocate of the 10,000-ton, eight-inch gun cruiser. It has been claimed in this country that eight-inch guns should be carried by cruisers in order that they may be able to dispose of ex-merchant vessels armed with six-inch guns. Arguments in favor of the large size of Treaty cruisers are based on the claim that this size is essential to obtain the necessary cruising radius.

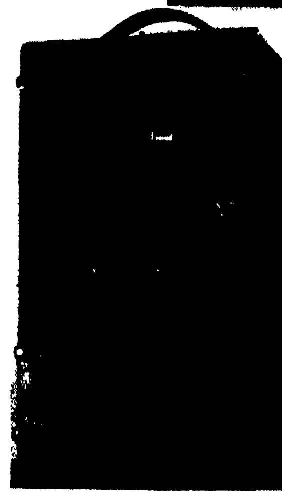
Whatever arguments may be advanced for or against the Treaty cruiser, however, we cannot escape the fact that during the late war, cruiser functions were carried out efficiently by much smaller and more lightly armed ships. Nor can we escape the fact that present 10,000-ton cruisers are so lightly protected that in all probability an engagement between two of them would be decided on the basis of luck. Moreover, to give such a ship adequate protection against eight-inch gun attack would require a sacrifice of speed. The resulting ship might be called a "pocket battleship" or more appropriately by the discredited name, "armored cruiser."

CRIMINALS PHOTOGRAPHED *IN THE ACT*

POSITIVE identification is the weapon most feared by organized crime and the ruthless criminal. Efforts have therefore been made for many years to produce a workable camera which would photograph the hold-up while the act is being committed. Now with the aid of especially fast film and very efficient lenses the problem of doing just this seems solved. Universal focus and ample field of view of the lens are of course essential to success. The problem is a hard one and considerable equipment is required; anywhere from one to five cameras are used so as to photograph the hold-up from various angles. The system is intended primarily for banks, other institutions that pay out or receive considerable sums of money, and jewelry stores.

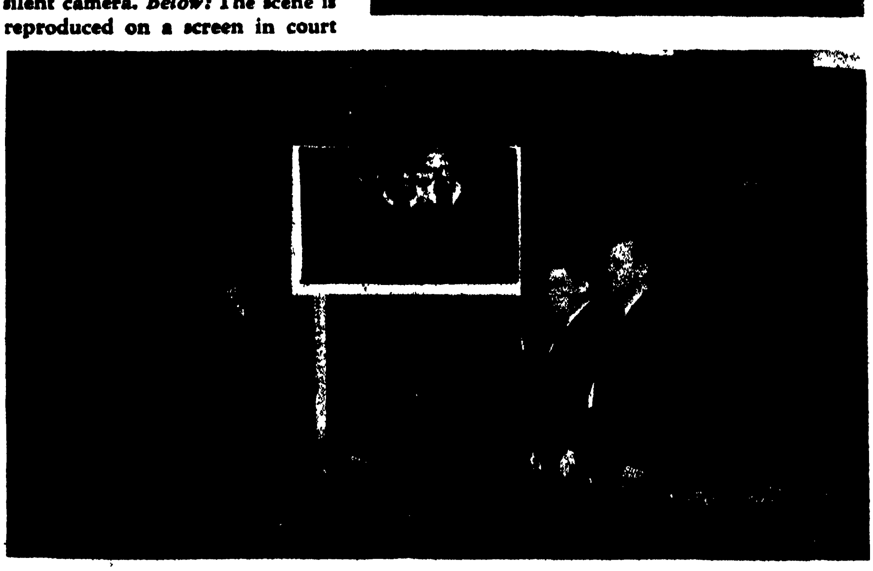
The cameras are concealed at strategic points by grillworks or other masking devices and may be started in operation in a number of ways which will not attract the attention of the bandits. Once the cameras start, a complete record of the robbery is secured. It has been determined that the average hold-up occupies only about three minutes. Each camera will make 240 exposures for each loading and it takes 12 minutes to run off the film.

The exposures occur at regular intervals of approximately three seconds. This is sufficiently frequent to follow the acts and movements of all parties concerned. Three exposure-time values are repeated consecutively, one of which will be approximately correct for the existing illumination at the time the camera is in operation. Of course the more light the better, but there will often be cases where the light will be comparatively dim. Under normal illumination of about five foot-candles of light reflected from the object, the shortest exposure used will produce identifiable pictures. Under low illuminating values the longer exposures will produce recognizable pictures down to one foot-candle of light reflected from the object.



***Left:* The front of the concealed camera. *Above:* The mechanism is operated by batteries; even if cables are cut the camera continues to work. *Extreme left:* Foot control. *Below:* Hand button**

***Right:* A scene at a hold-up. "Hands up!" is a too well known slogan. The bandits are being photographed by the concealed silent camera. *Below:* The scene is reproduced on a screen in court**



THE system is inaudibly started electrically, and when once started there is no stopping it. If the bandits should discover one of the wires, or if they were cut in an inside job, nothing can prevent the cameras from functioning; even the lens is protected by bullet-proof glass. Naturally the cameras must have motors to drive them, but they do not depend on an outside circuit and they are all driven by dry batteries so they cannot be disabled by cutting, shorting or destroying any part of the outfit. After the exposures have been made the negatives are developed and positives are made which can be utilized by the police in comparing the pictures in the "rogues' gallery." They may also be projected in court and there is a good prospect of re-enacting the crime. Two of our illustrations show a photographed hold-up where the victims are faced to the wall, and the same scene being projected in court for the benefit of the judge and jury. The system is known as the "Oshkosh Photo-Identification System."

What it Means to be Lazy

It May Not—in Fact it Probably Does Not—Mean What Many Think it Means. And the Condition is Curable

By DONALD A. LAIRD

Were you a lazy boy? Have you a lazy boy? Perhaps, in fact, you are a lazy boy. Well, then, here is good news: In such cases there is lots of hope. Many a lazy boy has turned out to be a genius. However, geniuses are comparatively rare, so let us omit that dream and see what the chances are of emerging from a state of laziness into no more than a plain, ambitious, ordinarily energetic average human being.

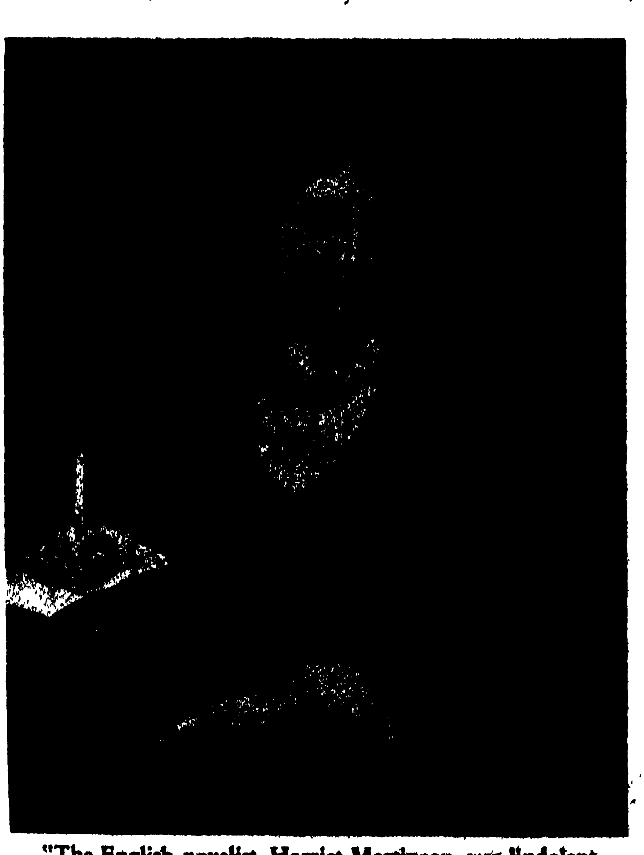
Laziness is seldom an absolute quality, like nearsightedness or flat feet or a tendency to have hangnails, but is relative to one factor—interest. If a boy is lazy he isn't hopeless; he just hasn't yet become interested in anything. If a man is lazy he has not yet found his work.

If we grant the above, ambition is not something which can be pounded into anyone, boy or man. A real interest is the prerequisite and one must be sought.—*The Editor.*

"He is so lazy that he hates to breathe," is a phrase used by midwestern farmers to describe their lazy farm-hands, and is sometimes extended to their own sons. Indolent boys and girls are a cause of considerable worry to parents the world over, and have been for generations.

Gioachino Rossini, the celebrated Italian composer, was so lazy as a boy that his father made him work the bellows for the blacksmith and invited his playmates to jeer him. Montaigne, the French essayist, was "lazy and languorous" at seventeen. The English novelist Harriet Martineau was "indolent in body," as her discreet critics phrased it. Another English novelist, William Makepeace Thackeray, was called an "idle boy" by his teachers, and "very lazy" by his school fellows. Justus Liebig, the famous German chemist, was so lazy that he kept faithfully at the foot of his school classes, in spite of the fact that his intelligence quotient is said by Stanford University psychologists to have been as high as 165, in contrast to the average intelligence quotient of a mere hundred. But perhaps such geniuses can afford to be indolent.

Amazing are the reports of the prevalence of laziness among ordinary children of the present day. One out of every eight children in 42 classes studied in Moscow schools by P. P. Blonsky, as recently as the year 1929, was found to be lazy—more than 10 percent of school children lazy. As the reader might suspect, the vast majority of lazy children denied that they were lazy; 80 percent of the lazy ones, in fact, denied that they were indolent idlers despite overwhelming evidence to the contrary.



"The English novelist, Harriet Martineau, was 'indolent in body,' as her discreet critics phrased it," meaning lazy

It is probably another instance of "like father, like child" in this regard. The grown-up and lazy loafer is not lazy, in his opinion; he is merely "thoughtful" or "does not believe in rushing into things half-cocked." Eighty percent of undoubtedly lazy children maintain that they are misjudged, and if a house-to-house canvass were made of adult loafers we should probably find about the same percentage of denials of the charge of laziness. In other words, 80 percent of us may be genuinely lazy and not know it, just as many fellows who insist on relating allegedly humorous incidents to entertain others, are in cold fact bores rather than entertainers.

The school children studied by Dr. Blonsky made another strange revelation—one that may cause much family discussion. Of all the girls only 4 percent were unequivocally lazy, but exactly 19.3 percent of the boys were discovered to be in this category of undeniably lazy. Think of it—more than four times as many lazy boys as girls; in fact, almost five times as many lazy boys! Can this be true?

Well, when we look into the outstanding problems of a thousand grown persons, equally divided between men and women, of the average sort, selected neither for their genius or their peculiar "dumbness," we find the confirming tendency for more men than women to have laziness their most difficult tendency to overcome. The exact figures show that 14 percent of men and nine percent of women have this human fault developed to an acute point.

So the "weaker sex" may not be as weak as men have alleged.

Plainly, women are not as lazy as men, whether the women are little girls yet in short dresses, or women in full-bloom and long skirts. This is all the more astonishing when we discover that the study of the same thousand men and women showed that, while only 11 percent of the men lacked energy to do more, 15 percent of the women showed this to be their greatest need.

When the energy of women

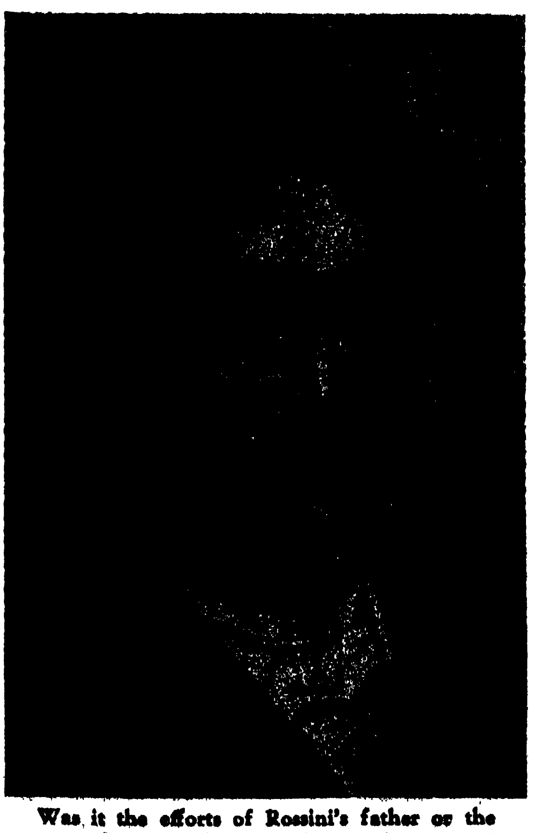
is measured by their metabolism it is found that they are about 15 percent below men in this measure of available energy. This fact, coupled with the observation that, periodically, women also have unusual physiological depletions of this energy, reflects but scant credit upon masculine indolence exceeding theirs. Here we find that women have more actual physiological justification for being lazy, but paradoxically it is the opposite sex that excels in laziness.

EVERYDAY observations confirm the scientific findings about which is the lazier sex. Laziness makes the automobile popular, many persons being, frankly, too lazy to walk. Every family knows who makes the most use of the automobile to avoid walking. Then, too, the husband buys a power drill for his home workshop before a family electric dish-washer is purchased. These little points are cited not to cause family arguments, but as common experiences which anyone can multiply by his own observations, in order to illustrate the point.

Being tired and being lazy are very different things, although it is easy to confuse laziness and fatigue. Women may fatigue more quickly than men, although they are less lazy. Medical examinations of the indolent children in the Moscow schools, for instance, revealed no illness or other medical reasons to account for their laziness. True laziness, such as we are discussing, is mental and not physical. It is caused by ideas and emotions, and is not caused by work or poor physical condition. The lesser laziness of women, in spite of their lesser energy available, shows it is a mental factor that underlies laziness. Tramps are not sickly weaklings; they are usually strong hulks of men with mental attitudes that make them shun exertion. Then, consider the hard application to work, against the obstacles of physical fatigue and actual illness of many outstanding personages:

Charles Darwin's body was always racked by weakness and illness; all the vast amount of creative scientific work done by this famous English naturalist was made only at the price of great effort against his physical frailty. The great German philosopher, Immanuel Kant, labored consistently against similar genuine physical fatigue and weakness. Always frail, and with his health giving away when he was 30, Friedrich von Schiller was still an indefatigable worker, often laboring for 14 hours a day in taxing, creative work. He worked when he should have been resting in bed, and this total lack of laziness—though he had every bodily reason in the world for being lazy—is generally considered an important reason for his almost complete loss of health while still a young man. Lack of laziness finally and heroically took him out of this life in a three-thaler coffin at midnight.

As a youth, Michel le Montaigne, the great French essayist, was "lazy and languorous"



Was it the efforts of Rossini's father or the natural course of events, that awoke Rossini?

An astonishing psychological experiment, which has been repeated many times, shows dramatically how potent the nervous system is in causing laziness. A person is made to lift a weight time after time with a finger, to the rhythm of a metronone, until he cannot move the finger a single time more. "My finger is tired out," the subject says, "the work has fatigued my muscles." But the weight-lifting has not fatigued the muscles of the finger, as the next phase of the demonstration experiment shows. A mild electric current is applied to the finger muscle to take the place of the nerve currents, and —lo!—the finger contracts, showing plainly that the muscle was not fatigued but that it was the "little grey engine," the mental machinery, that became tired of the exertion and gave up the job. The muscle was not tired; the mental powers and the nervous system through which these powers work simply "lazied" on the task of lifting weights, just as they lazy on many more important things. Women's muscles may tire more quickly than men's, but the findings previously discussed show that their mental machine does not give up and make them lazy.

What the mental factors are that make people lazy has been well studied in recent years by psychoanalysts in Vienna and Zurich, by industrial psychologists in England, and by vocational psychologists in America.

DAY-DREAMING is reported by the psychoanalysts to be a prominent cause of laziness. It is easier for the mental machine to take this course of idle reverie than to settle down to brass tacks and concentrate on some definite problem, although it is definitely known that we think faster when we are thinking constructively about a problem than when engaged in the pleasurable, albeit profitless, mental idling of "building castles in Spain." Practically everyone goes through a stage of intensified day-dreaming at about the twelfth to twentieth year, and some apparently never grow out of this indolent period of reveries. The tramp has been found to be especially active in day-dreaming. Reclining with his hat pushed over his eyes, he compacts the sward of the hoboes' jungle on the edge of town with his tattered clothes and dirt-encrusted body, while his mind wanders into Elysian fields. Although awake, his mind builds idle phantasies which serve no purpose other than their own fleeting generation. Like many other lazy

Thackeray was called an "idle boy" by his teachers and "very lazy" by his playmates

adults, he is lazy because he still has the uncontrolled and undirected imagination of a youth.

People day-dream because that helps them to surmount the difficulties of life through their imagination. Day-dreaming solves no problems, but it gives us the deceptive and fleeting pleasure that we can imagine they are gone. We simply try to wish them away. Hard knocks, disappointments and other similar mental experiences make day-dreamers out of many folk and, by doing that, make lazy people out of them. This should give us sympathy with lazy folks of our acquaintance, but does not explain the greater laziness of men, since theorists and practical scientists agree that womankind has more of these disappointments and frustrations than do men.

MENTAL causes for the laziness particularly of men are described by the English industrial psychologists and the American vocational psychologists. The hum-drum monotony of almost ceaseless industrial tasks is found by the industrial psychologists to cause great boredom which naturally, and almost inevitably, leads to a mental condition which readily promotes laziness. Sometimes this laziness does not become generalized, and we see the lazy, stalling worker hurrying home from the factory to work like a horse in a flower garden or building delicate and attention-straining models in a basement workshop at home. When interest in work wanes, laziness grows. So many men have to work at whatever is offered them, in order to earn bread and fuel and clothes, that this is almost a record-breaking cause of laziness. That is the reason why, when college students ask me what job they should take upon graduation, I always try to find out the job which would be likely to prove most interesting to their mental make-up; and why, in the laboratory, I am always studying the interests of the individual students, to make certain that I can get them to work on the one experiment we happen to have under way that will really fit in strongly with their basic interests.

The "dumb" man—or woman, for there are some "dumb" women, also—has been discovered by the industrial psychologists to be of a sort that seldom becomes bored with a job, no matter how monotonous it may appear. But men and women who are not "dumb" also have to work at these same jobs. Thus arises the tragic anomaly of the really intelligent people being more likely to become lazy—an important problem that the technocrats ignored and which might offset their entire theoretical system in actual practice. Because the majority of workers are intelligent, the majority of workers were therefore exposed to this pernicious and growing system which breeds laziness in strong and healthy bodies.

CLOSELY related are discoveries made by the American vocational psychologists—those of the appalling rate of change of job interests. Many, including famous persons, quickly become bankrupt of enthusiasm. Frederick Keppel found that approximately one half of men college graduates had widely changing vocational likes and dislikes, and Dr. Harry Dexter Kitson of Columbia University found that even among those in "Who's Who" a full 16 percent had changed their vocations in a major way. In rare contrast are those who know what they really want to do, and then proceed to do it successfully, in a straight-forward, and far from lazy, manner.

There is the rare Roy Chapman Andrews, for example, who knew full well at the age of ten that he wanted to be a naturalist and explorer, and has steadfastly and brilliantly followed through with no semblance of laziness. Or consider the brilliant young American writer, James Gould Cozzens, who knew definitely long before he entered college that he wanted to be a great writer. Without indolence he hewed to this line. We now see the reading public buying 5000 copies of one of his books in a single week, during a period when book stores have been going into bankruptcy.

We are indolent and lazy until we find our right work. Until we find this, we go through spells of laziness, with the inherent hazard that they may become fixed habits. Of course, a few favored persons may be fortunate enough to have the wide opportunity to fill many jobs at the same time. Such was the Rev. W. P. Young of Burlington, New Jersey, who, "in addition to being a minister, is a blacksmith, glass sign manufacturer, gas station owner, insurance agent, and crack harmonica player;" and who, more recently, is coroner.

THE stages that Robert Sessions Woodworth, distinguished head of the department of psychology at Columbia University, passed through are more typical of most folk. First he was going to be an astronomer, then he went back to the land and became a farmer. This was followed by his being a musician, then a minister, then a philosopher, then into the deep study of physiology, finally landing in psychology where he has been a powerful influence in guiding American psychologists from fascinating but futile fads and isms.

Thus we find that people who have not found themselves, or who are not satisfied with themselves inwardly, are the chief ones that contribute to our vast army of lazy loungers.

Some seem never able to gain such insight, however. Such was the case with the writer of a letter I recently received from Nova Scotia. He was a man just passing into middle age. He had found one of my articles interesting, but in place of writing his appreciation he wrote for me to tell him "what job he could get that required no work at all, and would make him rich."

The fact that Liebig the chemist was a lazy lad did not prejudice his future

From the Archeologist's Note Book

An ancient astronomical instrument

An Uncomfortable Royal Bed

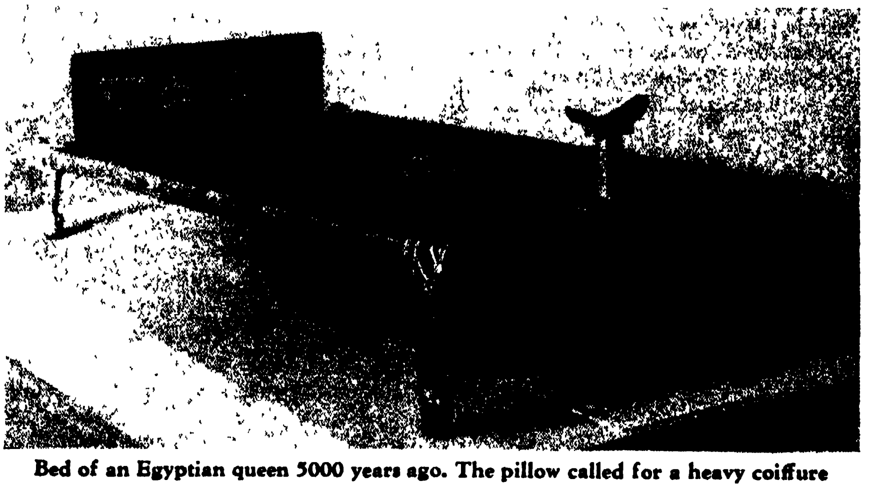
THE ancient Egyptians had good furniture, they drank wine and beer, used cosmetics, and were generally up-to-date but when it came to sleeping, a contraption that looked like an oar-lock was the torturing pillow. The bed illustrated is in the Boston Museum; it was reproduced from the original in the Cairo Museum. The bed slopes and a foot board kept the mattress from slipping off. The original, cased in gold, belonged to Queen Hetep-Heres I, mother of Cheops.

The Portland Vase's Rival

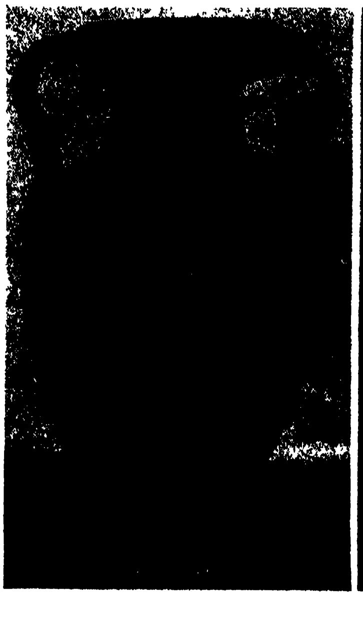
THE Portland vase, one of the world's finest art works, is a celebrated urn found in a sarcophagus near Rome. It is of dark blue transparent glass ornamented with cameos of opaque white glass, representing what are probably scenes from the legend of Peleus and Thetis. It was broken to pieces by a lunatic in 1845 and has been cleverly mended. At the Toledo Museum of Art, one of the outstanding museums of the Middle West, there is the so-called Libbey-Toledo vase of exquisite workmanship which Dr. Eisen, the great authority on ancient glass, says is superior in design and execution to the Portland vase. This author deduces from the representation of certain features on the Portland vase that the artist who executed it had a definite locality in mind, which he identifies as the promontory of La Gaiola in the bay of Naples. It is probable that the Portland vase in its original condition had a base; one of our illustrations shows how such a base would appear.

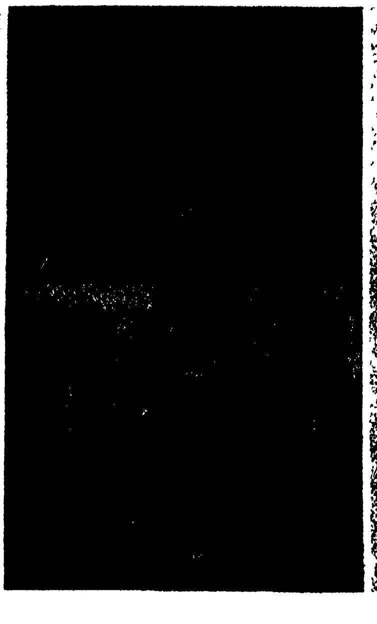
Astronomy in King Tut's Time

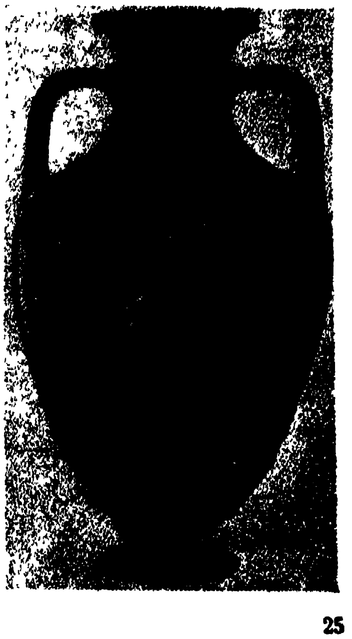
IN the Oriental Institute at Chicago is an astronomical instrument with which King Tutankhamen's astronomers, probably priests, took observations. The plummet, as mounted, was employed in setting the sighting instrument directly over the observer's meridian, presumably a north-south line marked on a pavement or temple roof. The observer could then determine when a star crossed his meridian, thus forming a crude stellar clock. The inscribed ebony handle and the plummet are ancient. The block and cord are restorations.



Bed of an Egyptian queen 5000 years ago. The pillow called for a heavy coiffure







Right: **The Libbey-Toledo vase in the Toledo Museum of Art rivals the great Portland vase, one of the world's masterpieces**

Center: **The Portland vase after restoration, but minus the base that it must have had when originally made**

Extreme right: **An artist has added a base to the Portland vase so that it assumes the symmetry of the Libbey-Toledo specimen**

THE DETECTION OF FOOD ADULTERATIONS

HERE is an article which leads you no farther than your kitchen to find interesting specimens and a practical application for your microscope. The branch of microscopy dealt with in it is so large that it can furnish material for a hobby in itself.

Naturally, so important a subject cannot be fully covered in an article and the microscopist will find the book, "Microscopical Examination of Foods and Drugs," by Henry G. Greenish, which can be obtained through SCIENTIFIC AMERICAN, a clear text on the subject.

The amateur is advised to follow the true scientific method from the outset of his studies and not come to too hasty conclusions regarding the purity or impurity of the food he examines. Findings should be checked and re-checked.—*The Editor*

THE complexity of our modern civilization makes it impossible for us to know what care and cleanliness has been exercised in the production and manufacture of the foods we buy. And, although the law requires that the ingredients be listed on the outside of the package along with the statement of the net weight, and that the product be made from clean unspoiled materials, not infrequently products can be found containing adulterants and impurities which can be detected readily with the microscope. However, we may be reasonably well assured that we receive wholesome, unadulterated, quality foods if they have been produced by reputable manufacturers.

For detecting some forms of adulterations, a microscopic examination is more dependable than a chemical analysis, because often the chemical composition of the adulterant is so nearly identical with the chemical composition of the pure food that a chemical analysis alone cannot be accurate. The microscope is a time saver, and aids to check the chemist's findings and to direct his searches.

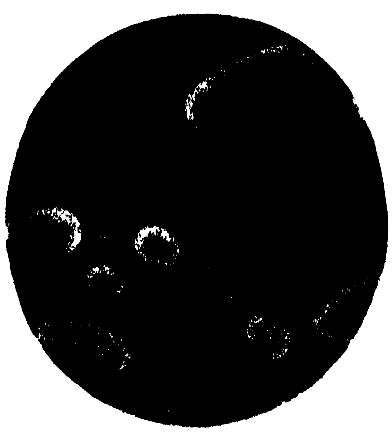
If the microscopist will make himself familiar with the physical structure of the starches and various ground substances which are used as adulterants, he can readily identify minute quantities of these materials in a mixture. A chemical analysis may show the presence of starch, but it requires a microscopic examination to determine the kind of starch present. Again, a chemical analysis may show a large quantity of crude fiber, which indicates the presence of a woody adulterant, but a microscopic examination is necessary to determine whether this woody adulterant is sawdust, chaff, hulls, powdered bark, or seeds. Accurate identification of these substances requires study and patient searching.

Some impurities in foods are not put into the product intentionally as adulterants by the manufacturer, but, through carelessness in the process of manufacturing, dust, sand, hair, insects, and waste materials find their way into the product. Adulterations of this type are relatively few, and are easily detected. The microscopist becomes well acquainted with the physical structure of the pure products he examines, and can readily detect particles which should not be present even in the most minute quantities.

Another type of adulteration is practiced by the unscrupulous manufacturer who purposely adds some cheap, bulky, or heavy substances to his otherwise pure product in order to reduce the cost, to swell the bulk, or to increase the weight. Some jam makers have been known to use a large proportion of some cheap fruit such as gooseberries in the manufacture of "raspberry" jam, but the seeds of the two fruits are so different in structure and appearance that such an adulteration as this can be detected with no difficulty at all. However, this type of adulteration is most frequently found in foods, such as coffee, cocoa, spices, and prepared flours, where various kinds of starches are commonly used as adulterants.

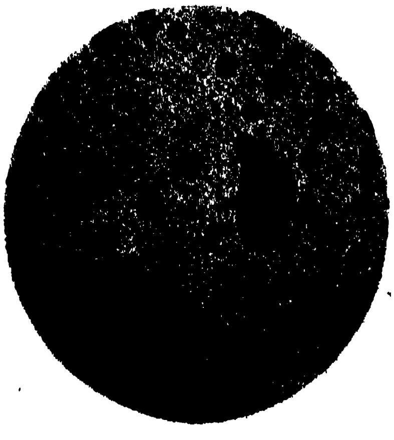
Although all starches are identical chemically, the various starch granules have many individual characteristics that make their identification possible when studied under the microscope. The several varieties of starch granules differ from one another in shape, size, natural markings, and manner of grouping, thereby making it possible to classify them into three main groups:

1. The circular group, including rye, wheat, barley, and tapioca.
2. The oval group, including potato, arrowroot, pea, bean, and lentil.
3. The polygonal group, including



***Above:* Typical grains of potato flour, magnified 500 diameters**

***Left:* Grains of arrowroot starch. Do not confuse this with potato starch. A few examinations will make them easily distinguishable**



***Right:* Breakfast cocoa adulterated with arrowroot starch. Magnified 200 diameters. The oval starch grains may easily be distinguished**

IICROSCOPE—VII

ND SPOILAGE—I

By K. BERNICE FICK, B.S.
Kroger Food Foundation, Cincinnati, Ohio

The author in her laboratory, making a microscopic examinations of adulterated foodstuffs

Indian corn, oats, buckwheat, and rice.

When starch granules are observed under the microscope dry or suspended in water, the outline is never clear or the details distinct; but, when stained with a very dilute solution of iodine and suspended either in water or glycerine, some starches become indigo, some blue, others purple and red. They stand out clearly against a white background, and certain individual markings appear very distinctly. The dark scar or marking on the starch grain is really its point of origin and is called the "hilum." This hilum varies in appearance with the type of starch as much as the shape of the granules themselves. Some appear as dots, some as circles, some as small slits, while others resemble the letter *x*. To see these markings plainly, the granules must be stained very lightly, because too much stain will make the whole mass appear as a dark colored spot. From a number of carefully prepared slides of the material suspected of adulteration with starch, when examined under the microscope, it is possible to determine whether the sample contains one kind of starch or a mixture of starches, the kind or kinds present, and to make a quite accurate estimate of the proportion of each present as an adulterant in the mixture.

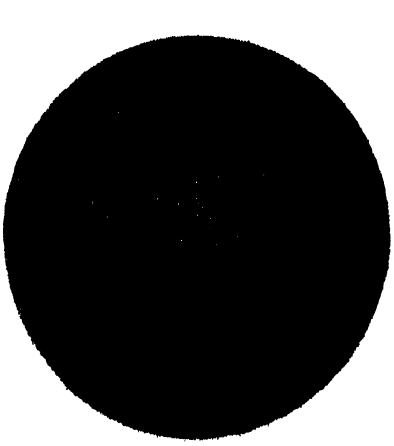
OFTEN the product contains some natural starch, and this must not be confused with the foreign starch which has been added as an adulterant. For example, cocoa contains natural starch grains which resemble rice starch, except that the grains are slightly rounded. Mustard contains small particles which resemble starch grains, but which really are small cells containing oil, and of course these cells do not stain characteristically with the iodine stain.

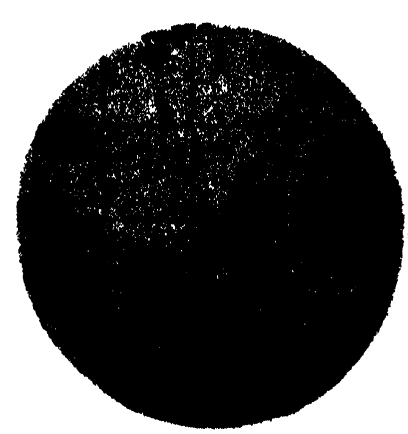
The amateur microscopist can find many food products containing starch right in his own kitchen. Some of these are pure starch, such as corn starch, arrowroot starch, and laundry starch; others contain an abundance of starch such as bread or cake flour, tapioca, Irish and sweet potatoes, and beans; and some few contain a mixture of starches such as pancake flour.

After the microscopist has collected some of these items in clean containers, his first duty is to prepare an iodine staining solution. This can be done by putting a small amount of ordinary tincture of iodine into a test tube or small bottle and diluting it with water until the solution becomes a medium amber color. Then, after he has cleaned a number of glass slides and cover glasses, he is ready to prepare his slides. This is done by dropping a drop of clean water in the middle of a slide and tapping a bit of the powdered material into it from a glass rod or pencil. Since the starch grains are comparatively small, a very small amount of the powdered material is sufficient. After the starch mixture has thoroughly dried on the slide, the slide is passed through a flame for "fixing." When cool, a drop or two of the staining solution is added and allowed to remain until the starch has turned dark blue. Then the excess stain is rinsed off with clear water, and a cover glass is carefully dropped over the darkest portion. After the bottom of the slide has been dried, the slide is ready to be examined under the microscope, which has been adjusted to give a magnification of 100x or 200x.

Since the potato is a solid material, it must be prepared for examination a little differently than a powdered substance. A fresh potato must be cut in half, and the cut surface lightly scraped with a knife to get some of the juice which contains the starch. This juice is dropped on the slide, dried, stained, and treated the same as dry materials.

(To be continued)





Above: **Typical woody adulterant**
Left: **Tapioca starch grains. 200x**
Right: **Corn starch grains—smaller**

Too Soon

Is as Bad as

Too Late

MAKING a scientific discovery or an invention years before the world is ready for it often turns out to be as disappointing as making it years too late. There is practical logic, it seems, in being *just* on the crest of the wave of public receptivity.

One man of science whose mind has worked about two decades ahead of the rest of us is the physicist, Professor Robert W. Wood, or simply R. W. Wood as he prefers to sign his name and as he is known to everyone in the world of science. R. W. Wood is a professor of experimental physics at the Johns Hopkins University, doing most of his research in that interesting corner of the science called physical optics. He has some kind of instinct—or call it "happenstance" if you will—for making experiments which later turn out to have widespread interest to the public.

Take, for example, infra-red photography, which he invented. Since he did this many appear to have re-invented the same thing. We see, here and there in this magazine or that, reproductions of infra-red photographs, but we see with them few mentions of Wood. In some way the captions beneath these photographs often create the impression that infra-red photography is a recent invention—perhaps of the man who took the photographs. No doubt, however, the unfamiliarity of editors with the special subject involved accounts for most of these instances.

SIMILARLY, someone—perhaps several—must have re-invented the infra-red method of making night views by daylight, widely used in motion picture photography—a method which has saved the motion picture industry millions of kilowatt hours. But it was R. W. Wood who made the original invention. The photograph reproduced below (at the right) is the first infra-red "night view" taken in full sunlight. This picture was made by R. W. Wood in the year 1909; that is, 25 years ago and long before the motion picture industry "invented" the same method.

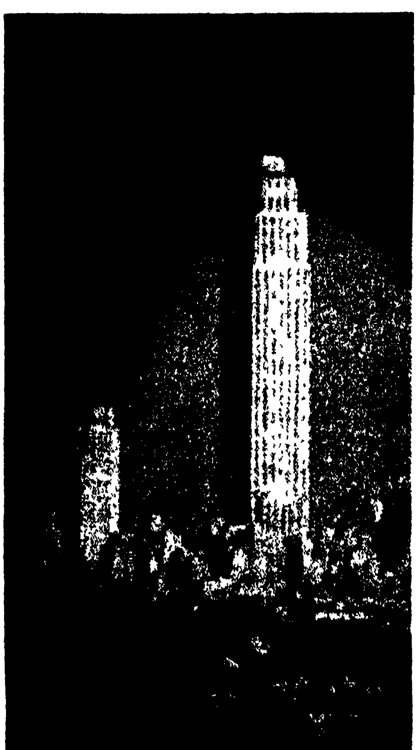
At the same period Professor Wood made the first photographs of the moon in ultra-violet light. A year or two later he lectured on the same subject at the Royal Institution of London, pointing out that an infra-red filter brings out distant landscapes by abolishing the obscuring haze. At that time the *Illustrated London News* published two pages of Wood's infra-red landscapes, but more recent publication of similar photographs gives us no clew to the original inventor. Wood's infra-red photography was also used to a great extent in the World War for photographing the earth from high altitudes.

Later, Professor Wood made ultra-violet and infra-red photographs of Jupiter and Saturn and the moon, with the 60-inch reflector at the Mount Wilson Observatory, and discovered belts on Saturn that had never been observed previously. The technique originated by him has been used to good advantage by others within recent years.

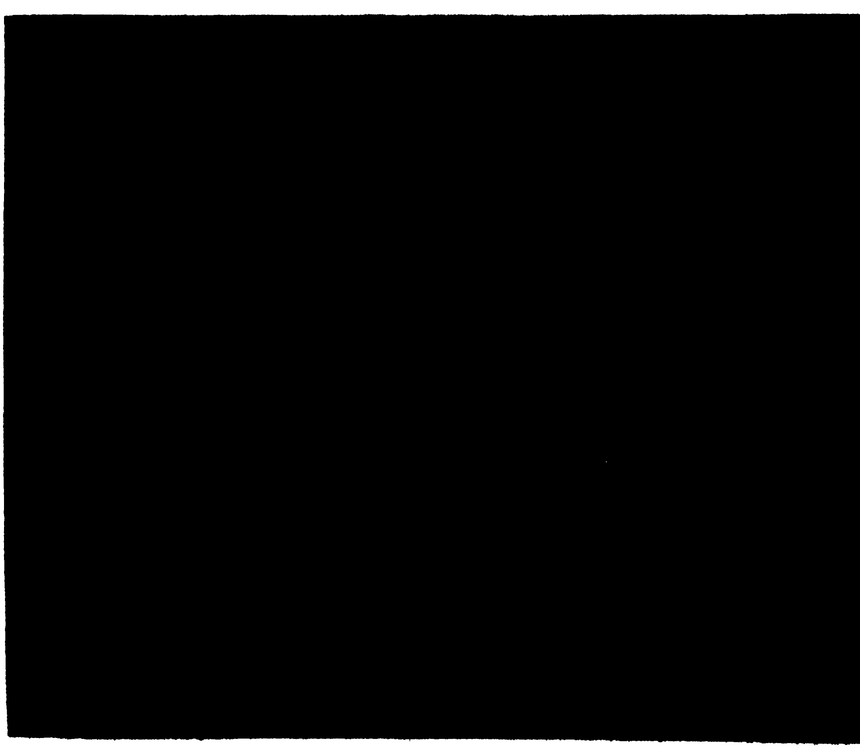
Wood showed, about 1909, that ultra-violet photographs will reveal erasures on checks and documents. A bureau of criminology in Vienna heard of this, obtained the details from him, and the method shortly afterward blossomed out as the "Vienna method."

Then it was Wood, also, who discovered the pre-fogging method of increasing the sensitivity of photographic plates. An account of this appeared in the *Astrophysical Journal* in 1903. But, according to a recent article in a photographic journal, this method was discovered in 1929 by someone else. Perhaps it was, but Wood was the first discoverer.

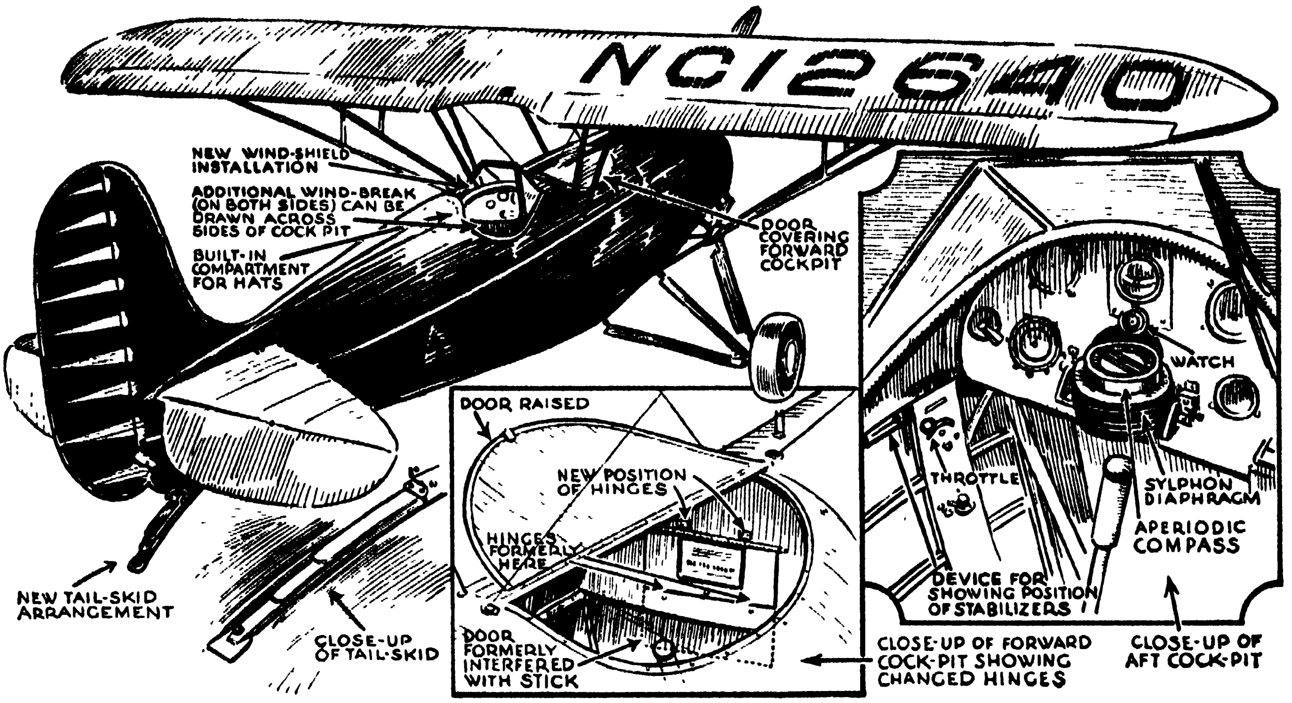
The only explanation of all these instances seems to be that Professor Wood was too many jumps ahead of the rest of us and that, when the world caught up, his work was too far back to be remembered.—*A. G. I.*



Above: **Infra-red photograph of the Empire State Building, taken from 18 miles distance, with a 6-inch telescope**



Right: **The first infra-red photograph ever taken was made by Professor Wood**



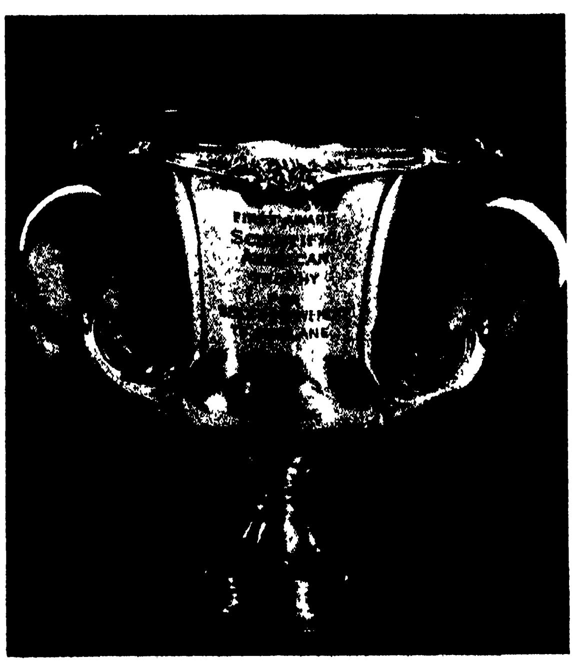
Details of improvements made to his plane by Luis De Florez, and described below

The SCIENTIFIC AMERICAN

AWARD FOR PLANE IMPROVEMENT

AT the National Charity Air Pageant recently held at Roosevelt Field, New York, one of the events attracted much attention among amateur pilots and plane owners. This was the competition for the SCIENTIFIC AMERICAN Trophy to be awarded to the sportsman pilot, who, in the opinion of a committee of judges, had made outstanding improvements in his airplane since its purchase. The chairman of the committee was Professor Alexander Klemin, with James B. Taylor, Jr., a well-known pilot, Jerome Lederer, chief engineer of Aero Insurance Underwriters, and William K. Rose, as the judges.

A system of marking was set up which gave points for general utility of the improvements introduced for increase in safety, for improvement in aerodynamic performance, and for novel and interesting instruments or accessories.



The trophy that was awarded

Careful inspection of a number of planes resulted in the award being made to Luis De Florez, consulting engineer of New York City, who introduced many ingenious and useful ideas into his Fairchild KR-22, a two-seater, open cock-pit monoplane, equipped with a Cirrus high drive or inverted engine, an excellent craft of well-tried reliability.

Mr. De Florez not only flies his own plane, but regards it as an interesting hobby and a sort of experimental station. Let us quote his personal views of what his airplane means to him:

"FROM the instant a pilot purchases a plane he becomes at once its best friend and severest critic. Flying some other person's ship does not seem to induce constructive criticism, and arguments which ensue as to relative merits only too often end in just plain disagreements. To the owner-pilot, however, who has made up his mind slowly and purchased a ship which suits him best at the time, it is a never-ending source of interest. Along with thoughts about what can be mechanically improved in the plane and how flying technique can be enhanced, it becomes only a matter of time before little by little the plane becomes filled with gadgets and those which remain are a mere fraction of those that have been tried and found useless. Along with these gadgets are innumerable other details which are usually tried, such as different kinds of waxes and polishes, lubricating oils and fuels, and so on. The plane becomes a mild form of experimental station from which some worthwhile contributions in design

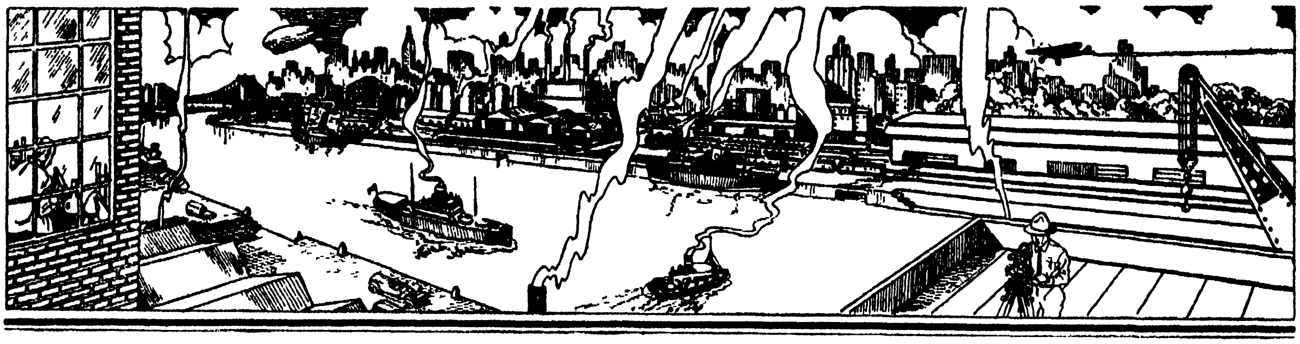
(*Please turn to page* 34)

Courtesy The Illustrated London News

Modern Catacombs Protect the French Frontier

In recent years, France, taking example by the lessons learned in the World War, has created an extensive system of fortifications along her frontiers. Some of the projects built for this purpose consist of strong forts while others are more spectacular in that they are composed chiefly of subterranean structures. The diagram above shows a section of the underground fortification system on the eastern frontier of France. The essential points of this system, built on a gigantic scale and believed to be the strongest ever evolved, consist of a line of fortified casemates giving each other mutual protection by cross-fire and interconnected by underground galleries safe from bombardment. As may be noted in the drawing, the above-ground portion of the casemates is concealed by trees and other natural barriers. Below ground are galleries to contain ammunition supplies, others containing power plants, living quarters, and various appurtenances. At intervals along the communicating galleries the casemates rise to the surface on shafts in which there are electrically operated lifts, or elevators. This system will permit a sudden concentration of troops in an emergency. Means have also been provided to close the whole frontier completely within a few hours after an alarm is given.

According to *The Illustrated London News*, "Plans for the 'Maginot line,' so called after the late War Minister, M. André Maginot, who was in charge of the works, were first submitted in 1925 when it was decided to make a stretch of about 200 kilometers as far as possible impregnable." It is believed by those who maintain the thesis that adequate preparation for war operations is the best insurance against the outbreak of war, that this system of defense will go far toward preserving peace in Europe.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

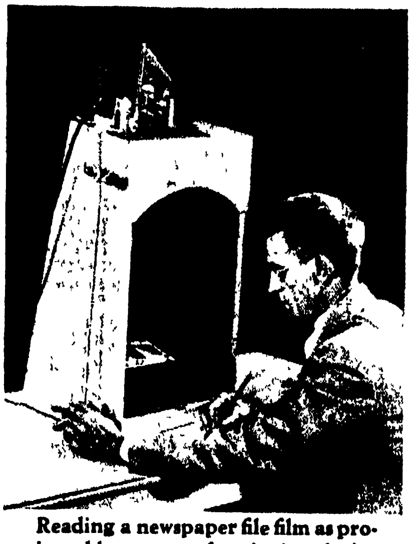
Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

Newspaper Files Kept Photographically

A PROCESS by which files of newspapers may be preserved for posterity on photographic safety film was described recently by Charles Z. Case of the Eastman Kodak Company. This process is made possible by the development of a camera



Reading a newspaper file film as projected by means of a viewing device

that can photograph more than eight full-size newspaper pages on a strip of film 1⅜ inches by 12 inches and a month of 50-page papers on a single reel less than four inches in diameter.

The deterioration of newsprint paper in files has presented a serious problem. By putting their back numbers on film, which is chemically much more stable than newsprint, newspapers are expected to be able to preserve their files indefinitely.

The film can be read in newspaper offices on a simple viewing device that will enlarge the tiny page images from the film up to half again the size of the original newspaper page. Articles from the files may either be read from the viewing device or may be copied full size on photographic paper.

The new miniature-image process is also useful for public libraries, which store large quantities of newspapers. Here not only permanency of newspapers but also economy of storage space is important. If files on film were installed in public libraries, a person coming in to read back files of a newspaper would be given a film to examine on the viewing device instead of a large bound volume of papers.

Linseed Oil For Dirty Hands

ORDINARY linseed oil is recommended for the removal of dyes, lacquers, lacquer paints, tar, and so on, from the hands. It is only necessary to rub about a thimbleful of ordinary linseed oil between the hands until all the materials are dissolved. Then, without wiping off the oil, the hands are washed with any soap in cold, or preferably warm, water. The soap emulsifies the linseed oil readily and yet lathers freely. With linseed oil, the oils of the skin are not removed, as in the use of benzine, gasoline, turpentine, and the like, but on the contrary, the skin is kept soft by the small

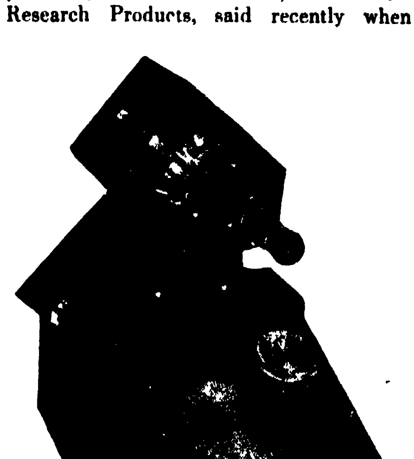
A full frame and part of another, reproduced in the exact size as used for photographing newspapers for filing

amount of residual linseed oil which remains even after washing with soap suds.

Hands which were seriously damaged by the former use of benzine, turpentine, and so on, have been healed completely within a short time by employing the linseed-oil method of cleaning. Only when the lacquer or dye residue has aged and is very dry, as happens with rapidly drying lacquer paints, is it necessary to warm the linseed oil. However, hot linseed-oil baths are an outstanding remedy for cold and chapped hands. For freeing the hands of spirit lacquer and cellulose lacquer, stearin oil (olein) may be used in place of linseed oil, which is also more effective when warm. In this case also, soap and water are used. —*A. E. B.*

New Compact Watch Timer

JEWELERS may soon be using the slogan, "Have your watch regulated while you wait," Charles H. Fetter, of Electrical Research Products, said recently when



A watch, placed in the open part of this device, is timed in ten minutes

demonstrating an electric watch timer. This compact device, developed by Bell Telephone Laboratories, permits any jeweler to regulate a watch to the maximum of its time keeping efficiency in 10 minutes, compared to about ten days now required by jewelers to adjust watches properly. The device is approximately the size of a standard typewriter.

When the watch is placed in a compartment of the timer an image of the watch fly wheel is reflected on a mirror, permitting a comparison of the watch speed with a flashing lamp. By a very simple adjustment of the timer, the actual loss or gain in seconds per day made by the watch may be read directly from a dial on the timer. With such a device in his repair depart-

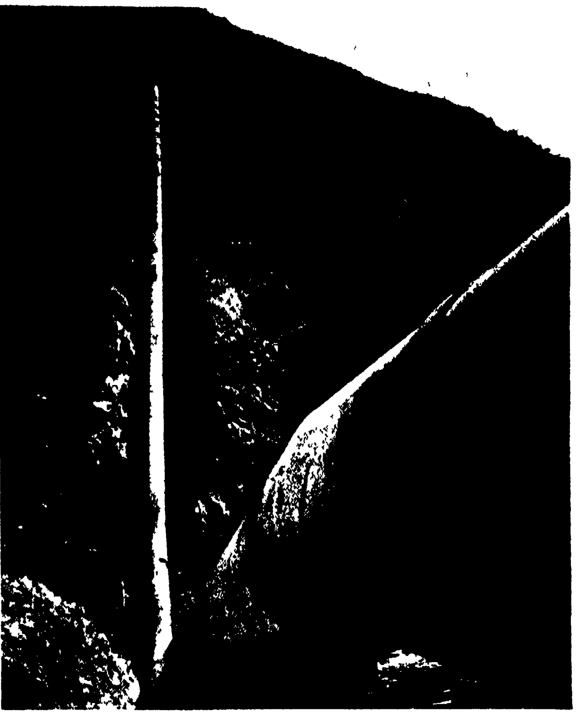
ment, no jeweler need keep a customer's watch more than one day for accurate adjustment.

The motive power which drives the timer is a one hundred cycle current transmitted over wire and furnished by the telephone company from a constant frequency generator located in New York. The frequency of this current is accurate to one part in ten million.

Sulfur Dioxide as a Germicide

THE value of freshly made dilute solutions of sulfur dioxide as a disinfectant is reported in *Chemical Markets*. The experimenters dissolved 10 grams of sodium hyposulphite in one litre of warm water and added 1.5 cubic centimeters of concentrated sulfuric acid. The solution became turbid owing to the precipitation of sulfur. Instead of the sulfuric acid, sodium bisulfate can be used, and the disinfectant trials were carried out with the solutions made by the latter process. An improved bactericidal effect was noted, particularly on staphylococci. The solution, it is suggested, should be used as an antiseptic for wounds and in surgical operations. Doses of from 0.5 to 20 cubic centimeters of the solution have been injected subcutaneously and intravenously into dogs without any harmful effect being observed. *A. E. B.*

Conquering canyons and straddling mountains, a four and one half mile arc-welded pipe line will soon join the Bouquet Canyon Reservoir with the Owens Valley Aqueduct, near Saugus, California. The line will form part of the water supply system of Los Angeles. This pipe line, said to be the largest in the west, varies from seven feet ten inches to six feet eight inches in diameter, depending on pressure. It takes approximately 450 pounds of electrode to weld each joint. At the bottom of one of the canyons crossed, the pressure on the pipe is 400 pounds per square inch. The photograph at right gives a faint idea of the territory traversed by this line. (Courtesy Lincoln Electric Co.)



Shotgun Shells Test Copper Tubing

THE strength of modern plumbing materials was dramatically demonstrated recently by two experimenters for the Chase Brass and Copper Company, who fired 12 gage shotgun shells in a cannon whose barrel is a 10-inch length of seven eighths inch copper water tubing. The breech is a regular brass pipe adaptor sweated to the copper water tube barrel and closed by a pipe plug drilled to receive a steel firing pin. The trunions of the cannon are saddle tees, sweated on and filed down to fit smoothly over the barrel. Despite the recoil shock that jolts the cannon into the air and slams it against the recoil blocks, these tees show no sign of tearing loose.

The barrel does not fit tightly around the shell (except at the extreme rear) but clears the shell all around by about one sixteenth of an inch. This gives the powder gases more room to expand than in a regulation shotgun, reducing the force to some degree. Heavy wads of damp cotton and paper are tamped down on top of the shell to insure the complete burning of the powder charge.

"This experiment should not be attempted by anyone except men skilled in the technique of handling explosives," warns the man who built the cannon. "I was surprised to find that copper water tubing could stand the shock of three drams of smokeless powder. Under some conditions this can split a steel shotgun barrel. My advice is not to play with gunpowder—there is too much danger of serious injury."

Carbon Dioxide Preserves Eggs

COLD storage eggs that can't be told from fresh, even when eight months old, are reported to be produced by a method utilizing carbon dioxide gas as the atmosphere in the storage chambers. According to W. M. Zarotschenzeff, who describes the process in *Food Industries*, the problem of preserving eggs in good condition is very delicate, because of the biological and physiological changes occurring in the eggs during ordinary refrigeration.

In the carbon dioxide process, carefully selected eggs are placed in sealed steel chambers, located in a room maintained at 34 degrees, Fahrenheit. The chambers are sealed with air-tight doors and the air is exhausted. A carefully regulated atmosphere of carbon dioxide gas is now introduced and is maintained at a pressure slightly higher than atmospheric to preclude the possibility of air leakage inward. A natural circulation of the gas inside the autoclave is effected by placing a cooling coil along the outside of the chamber. Condensation of moisture takes place at the coolest point on the side walls, and runs to the lowest level of the chamber without dropping on the eggs. A drop of water in the carbon dioxide atmosphere is objectionable, as it makes the egg shell coarse and covers it with a white sediment.

Although costs are slightly above those of ordinary storage, the increase in expense of the method is said to be offset by the better market price commanded by the gas-preserved eggs.—*A. E. B.*

Vitamins 'à la Carte'

WE will soon be buying our vitamins by the pound and sprinkling them on our victuals like so much salt, if Dr. George A. Curme, Jr., America's leading industrial organic chemist, envisions correctly the future development of physiological chemistry. Speaking as the recipient of the Chandler medal in New York recently, Dr. Curme pointed out the fundamental impor-

Loading and firing the copper-tube testing cannon

SCIENTIFIC AMERICAN Award for Plane Improvement

(*Continued from page* 29)

and construction often emanate."

The ship in question was purchased in the spring of 1932 and was one of the first models of the Fairchild KR-22. Improvements in structure of the ship gradually suggested themselves. For example, it was found that the tail skid fittings were inadequate and of the wrong shape, resulting in broken spring leaves. After repairing the tail skid several times, it was found that an additional flat plate corrected the difficulty. A door within the baggage compartment in the front, where a dual set of controls is installed, opened downwards and on one occasion fell open and caught the dual stick, preventing its forward travel. This was corrected by putting the hinges on top of the door.

The fittings on the base of the stabilizer struts were rigid and movements of the stabilizer tended to bend the gusset plate to which the struts were attached. These were changed to hinge joints, although no failure had occurred. Stouter drag wires were put into the wing, and investigation as to the crystallization of wire terminals led to a change in the wire fittings to the present standard which allows universal motion of the wire ends.

In the case of the engine, the Cirrus high drive, considerable difficulty was experienced with valve seats. This was eventually overcome by the use of a different type of seat metal, improvements in the air cowling, and the use of thermo-couple wires to indicate temperatures on all four cylinders. The exhaust manifold was bolted rigidly to three cylinders, although the fourth had an expansion joint; it was found that cracks developed in the manifold and two other expansion joints were added which eliminated the difficulty. All fuel and oil lines were taped, partly to damp vibration and partly to act as a possible safe-guard in the event a crack developed. A metal propeller was substituted which improved the performance of the ship materially.

The instrument equipment of the ship is perhaps of most interest. It consists of the usual line of instruments—air-speed meter, altimeter, tachometer, temperature and pressure indicators, turn and bank indicator, and compass, all mounted and connected to reduce the effect of vibration. Special mention should be made of the compass. Mr. De Florez personally became accustomed to reading a compass of the marine type through years of sailing and found that the ordinary dash compass reading on the rear of the card always required a mental effort. In addition to this, the difficulty encountered in the swinging of the card, due to friction of the pivot and

Luis De Florez, winner of the *Scientific American* Trophy, and plane

the fluid, makes it extremely difficult to use a compass when flying in bad weather.

After investigating various types of compasses, it appeared that the aperiodic type with a light needle was best suited for aircraft work. These, however, are usually mounted on the floor and used merely to set a course. Due to the facts that many ships are small and weight is of importance, and that the expense of buying two compasses, one for the dash and one for the course setting, is somewhat out of line, it seemed desirable to develop an aperiodic compass which might be placed on the dash and read directly as a steering compass, at the same time permitting accurate course setting. The difficulty in mounting such a compass in a small ship, or in fact, any ship, is that vibration blunts the pivot; unless large and relatively clumsy mounts are available, satisfactory readings cannot be obtained.

After some months of work with sponge rubber, felt, and various vibration absorbing material, it was found that the most effective means of mounting consisted of a copper bellows on which the compass bowl rested. This bellows is rigid torsionally so that the compass can be secured with a lubber line on the longitudinal axis of the ship and yet the setting will give sideways, vertically, and will even rock. In order to damp the motion of the mounting, the convolutions of the bellows were filled with felt rings and the compass bowl sealed into the bellows with the exception of a very small aperture which allowed air to flow in and out. The pumping effect of the bellows through this small aperture constituted a very effective means of damping vibration. The result has been that with this type of mount, which has recently been adopted by a compass maker, the shocks on the pivot have been prevented and vibratory effects on the needle appear to be completely eliminated. This permits a more delicate pivot with less tendency to swing.

With regard to the operation of the plane, it might be mentioned that the ship is equipped with a self-locking throttle whereby the setting stays wherever placed, preventing creep which is so undesirable and annoying on long trips. The owner has also constructed a very simple stabilizer indicator which is valuable in trimming the ship for best speed and acts as a reminder of the position of the stabilizer before take-off.

As far as the comfort of the ship is concerned, a hat compartment provides a much needed space for a straw hat in the summer time, free from grease and dirt. Perhaps the most important comfort features are the wind-shield and the side covers which virtually eliminate draft in the cock-pit and yet permit excellent visibility. The wind-shield comprises three slanting surfaces, flat in front, the two sides being at somewhat of an angle and the whole tipping rearwards. By dint of trial, the angle of the surfaces and their size and position were so arranged that the air stream could be carried well overhead and sufficiently away from the sides to permit a good view forward and downwards. Side covers extending from the base of the wind-shield to the head rest eliminate back draft. These are arranged on clips. The top edge is formed by a rubber shock cord. These can be readily fastened and unfastened, and in the event of an emergency the shock cord will give in such a manner as to allow the occupant to leave the cock-pit.

These improvements, in combination, constituted, in the opinion of the judges, a very important help to the serviceability and reliability of the ship. It is interesting to see what a private owner can do in thus furthering aviation.—*A. K.*

tance of vitamins in making bulk foods available in animal metabolism.

"As this vitally important development is still largely in the laboratory research stage," he said, "it is not yet possible to visualize the exact course which it will take. Each month brings additional information, and experimentation is being conducted at so many points by individual groups that a complete correlation of existing knowledge is not yet possible. A definite beginning of commercial operation, however, is already under way, and within the past few years at least five companies in the United States have put on the market products containing vitamin D made by the irradiation of ergosterol, using the Steenbock process. Vitamin A is known to be closely related to alpha- and beta-carotenes, vitamin B is believed to be closely related to adenine (6-aminopurine) and vitamin C is probably identical with or closely related to hexuronic acid.

"All of these substances are of such a degree of molecular complexity that synthesis from the elements or their elaboration from other naturally occurring materials seems entirely possible. In the case of the other vitamins, less is known, although it would be surprising from the information now available if they were beyond the range of synthetic chemistry. Accordingly it appears that adequate supplies of vitamins will soon be available from relatively cheap and abundant sources, and that under the guidance of physiological chemists and dietary experts synthetic chemistry will be able to add another triumph to its many past successes."—*A. E. B.*

Longer Engine Life

A 400-hour endurance test of the Wright Whirlwind 275 horsepower engine is reported rather fully in a recent issue of *Aero Digest*.

Fifteen years ago the life of an airplane engine was approximately 300 hours and overhauls every 25 to 50 hours were the rule. To-day the average life of an engine is 2500 hours and overhauls may be spaced 250 or even 300 hours apart. Although there has been no basic change in design principles in this long span of time, there has been progress in detail design, in better materials and heat treatment, and in better lubricants and oiling systems.

The 400-hour test, for the most part at full throttle, gave some remarkable results. There was no loss of power at the end of the grueling ordeal; wear was negligible; and clearances remained practically the same. The bearing surfaces remained smooth and polished. All that had to be replaced to get the engine into perfect condition was a valve guide, a crankcase bearing sleeve, two exhaust valves, a set of piston rings, gaskets, and rubber oil seals.

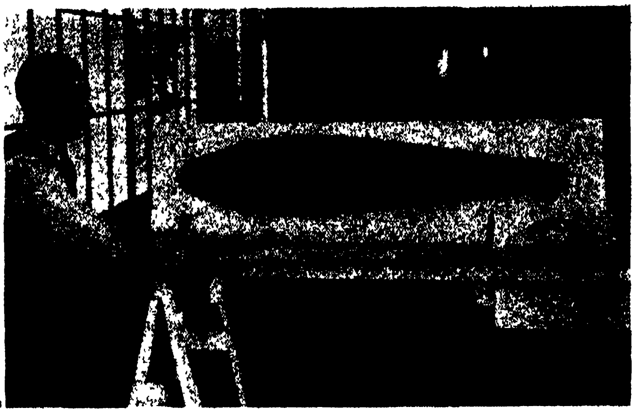
A study of these results indicated that even longer periods between overhauls could be obtained with improvements in exhaust valves, and reduction of dirt in the lubricating oil. Better valve seats, and careful filtering of air and oil to prevent entry of dirt may eventually raise the overhaul period to 800 hours. Such improvement would be of the greatest significance to operating economy, which airline operators are always pursuing.—*A. K.*

Trailing Wire vs. Antenna Mast

AIRPLANE designers try to streamline their craft to the limit, but the operators of the airlines sometimes carry the streamlining process even further. Thus, Transcontinental and Western Air found that the mast type airplane antenna reduced the cruising speed as much as four to five miles per hour. Accordingly, they reverted to the trailing wire type and found its drag to be negligible, its effect on cruising speed practically nil Another advantage of the trailing wire antenna also lies in the solution of the problem of ice formation. The mast type presents a comparatively large surface on which ice frequently forms. The trailing wire antenna is immune to ice even under the most unfavorable weather conditions. -*A. K.*

Zap Flaps and Ailerons

ONE of our photographs shows the application of the Zap flap to a Navy XOJ-I plane built by the B/J Aircraft Corporation. The flap is placed on both the upper and lower wings, and is a simple surface of thin sheet metal with appropriate corrugations for strengthening purposes. The flap slides back and down, and thereby increases the lift and also the drag of the wing. Therefore, it is possible both to decrease the landing speed and to glide down at a steeper angle in safety. Unfortunately, when the flap extends along the entire span of the wing there is no room for the ailerons of the conventional type and a totally different aileron system has to be employed. Such ailerons are mounted several inches above the wing and are hinged at an axis approximately 25 percent of their chord from the leading edge. These so-called Zap ailerons work quite well, but their disposition has to be very carefully studied. They have to be just at the right distance above the wing and just at the right position along the chord of the wing. It is not by any means certain that this is the sole type of aileron that eventually will be used with the rear edge flap. —*A. K.*



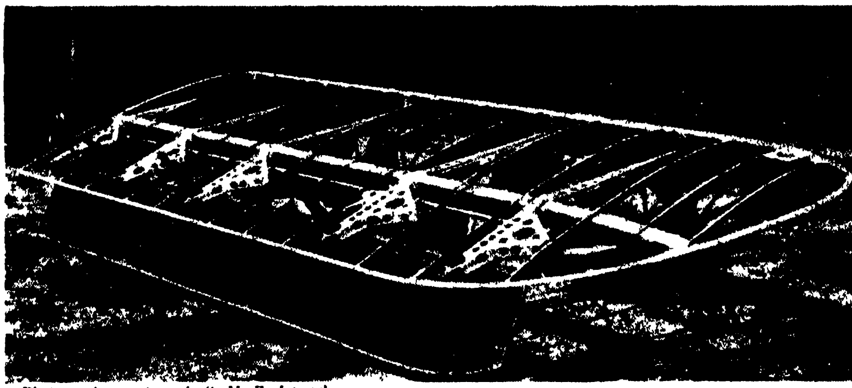
An airplane fuselage modeled in clay, as one of the preliminary steps in the design of a new plane. Airplane designers have to be sculptors as well as draftsmen

Aircraft Sculpturing

IN working out the streamlining of their modern designs, Boeing Airplane Company engineers have to be sculptors as well as draftsmen. A photograph in these columns shows one of them beside a half section model of a pursuit fuselage, done in modeling clay. By this method engineers are able to get a better conception of body lines and of fairing than from plans on paper. Wooden templates are used in making the models to exact dimensions. Similar methods are employed in the fairing of wings into fuselage, and so on, and also in wind tunnel experimentation. The man with a good "thumb" may be able to increase the speed of his ship several miles an hour. - *A. K.*

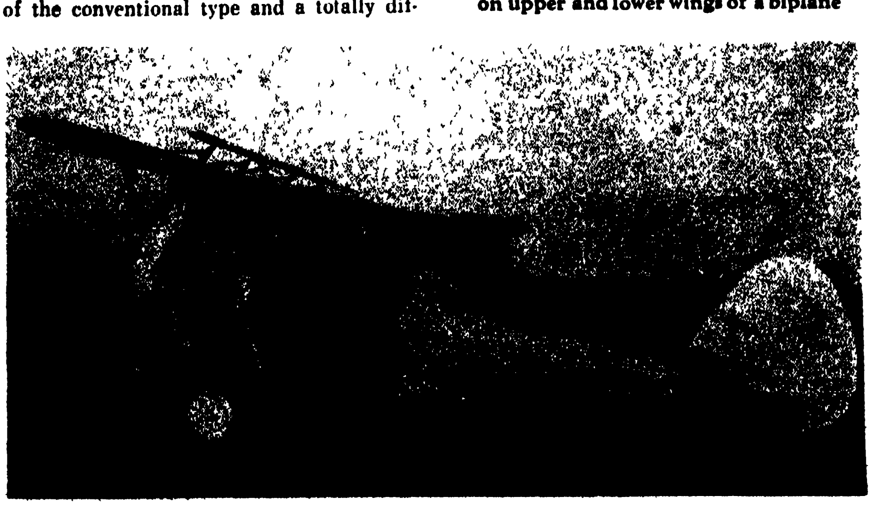
Safer Than a Motor Car

IN the first six months of 1933, according to figures of the Department of Commerce, there was one passenger fatality for each 38,231,196 passenger-miles flown by the regular air transport lines. In the same period, according to statistics obtained from the American Automobile Association, motor cars in the state of Missouri drove only 15,581,475 passenger miles for each passenger fatality.



Photographs courtesy *S M E Journal*

A Zap flap installation before wing covering is applied. *Below:* Zap flaps on upper and lower wings of a biplane



These figures indicate that flying on the regular air lines is twice as safe as riding in a passenger car. Even if we assume Missouri to be a hazardous state for the motor car, and even if we take the recent crash of a transport plane in the west into account, the airline operators have reason to be proud of their safety record.—*A. K.*

Airplane Ambulance

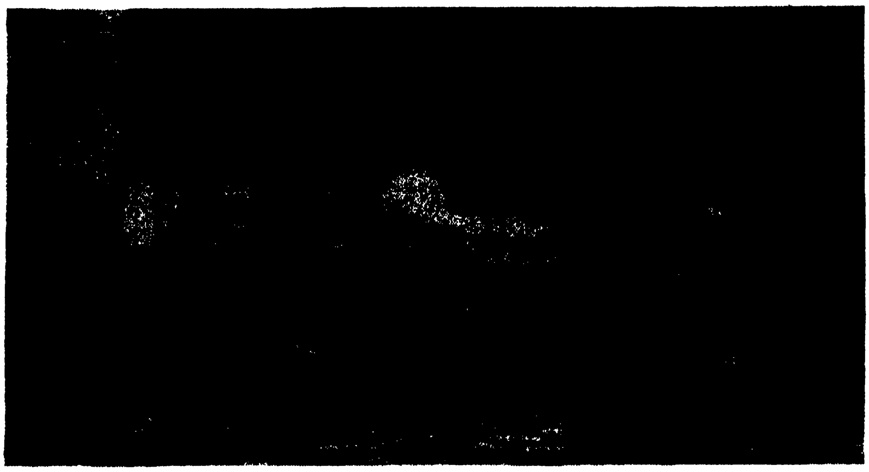
AN interesting case of the use of an airplane as an ambulance occurred recently in Pennsylvania when a man to whose spine a part of his shin bone had been grafted was flown from a hospital in Philadelphia to his home in Bloomsburg. Due to the fact that his wound would require several months to heal, a special carriage had to be constructed in the interior of the plane so that his trip might be made in a prone position.

Physicians interested in the case ex

plained that the operation which had been performed was most unusual as it was only the fifth of its kind to be performed in this country.

A Seaplane Base for New York

NEW YORK CITY'S main airport is at Newark, New Jersey. Strange to say, its seaplane base may also be on the Jersey side of the Hudson. This is the Metropolitan Seaplane Terminal, which is built on



A seaplane on the turntable of New York's new seaplane base

a large navy barge, 164 feet in length, moored to the north side of Pier B in Jersey City. The advantages of the Jersey side for seaplane operation are that traffic is lighter than anywhere else in the Hudson or the Bay, the distance between docks is so large that aircraft operation is possible, and the current never exceeds 1.7 knots.

The forward portion of the barge is devoted to an observation deck; the rear is arranged as a modern passenger terminal But the most interesting part of this simple yet efficient terminal is the floating ramp. This is attached to the side of the barge some distance below the deck level, and can be reached by a permanent stairway and gang-plank. The ramp is so ballasted that it is inclined at an angle of approximately 15 degrees. On the ramp is a turntable some 25 feet in diameter, planked with wood. The turntable may be rotated through 360 degrees and is manually operated by a crankhandle. The seaplane is hauled up the inclined ramp, head on, and the turntable is rotated until the passenger exit is in the right relationship to the gangway. —*A. K.*

Naval History and SCIENTIFIC AMERICAN

IN connection with our article on cruisers appearing on page 18 of this issue and particularly the boxed note in which we promise a number of authoritative naval articles during 1934, it may be of interest to our readers to note the following comment reprinted from a recent issue of the *United States Naval Institute Proceedings*. This comment is indicative of SCIENTIFIC AMERICAN'S naval traditions, containing as it does a reference to an article published by us which is considered important in naval history. The quotation follows:

Several interesting queries have been raised by Mr. William H. Morgan of the Morgan Engineering Co., Alliance, Ohio, regarding a statement in Admiral Fisher's "Memories and Records" (Vol. 1, pp. 22-23) to the effect that the concentration of the British fleet in home waters in 1908, because of the menace of Germany "was so unostentatiously carried out that it was only Admiral Mahan's article in the SCIENTIFIC AMERICAN that drew attention to the fact, when he said that 88 percent of England's guns were pointed at Germany." Mr. Morgan's first question was as to the location of the SCIENTIFIC AMERICAN article, which is not included in the bibliography in Taylor's "Life of Mahan." As a matter of fact it appeared in the SCIENTIFIC AMERICAN for December 7, 1907, and contained the following remark: "I take it from the statement (in *Brassey's Naval Annual*) that by May, 1908, 86 percent of the British battleship strength will be concentrated in or near home waters."

Mr. Morgan's second query is as to why, if the information appeared in *Brassey*, it should have required Admiral Mahan's comment to bring it to the attention of the world, and why Admiral Fisher should have given him special credit for so doing. To this the only answer seems to be that we have here simply another instance where the significance of facts is disregarded until it is pointed out by a keen, analytic mind.

Mr. Morgan closes his letter with the remark: "I am very much an admirer of Admiral Mahan, and I think it most unfortunate that he is not appreciated by the average American. Everyone knows of Paul Jones, Decatur, Hull, Perry, Farragut, and Dewey, but Mahan, who I think is head and shoulders above all of them, isn't even known outside naval circles."

"Mercury Made" Motor Oil

SOME of our friends who read the "ads" have asked: "What is this motor oil 'made by the mercury process?' Has it mercury in it?"

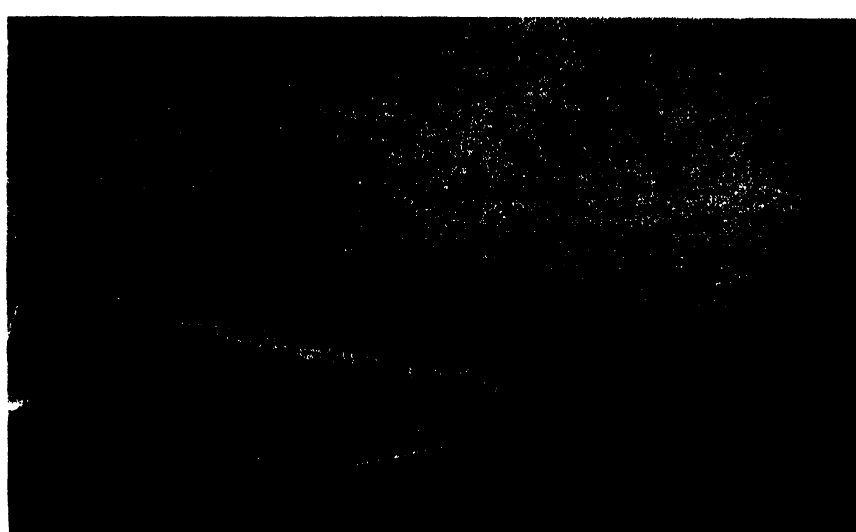
The answer is, no; there is no mercury in it. "The mercury process" refers simply to the manner in which the crude oil is heated in the stills where it is refined. Up to the present, heating in petroleum distilling units has been done more or less exclusively either by direct firing or by steam heating. Indirect heating mediums other than steam are becoming more and more popular due to the desire to use high transmission temperatures without the use of a heating medium at high pressure, and also to maintain closer control over the heat transmission process. The Sun Oil Co. uses mercury as an indirect heating medium.

Another system, based on the same principle of indirect heating, uses the organic chemical diphenyl which, like mercury, vaporizes at elevated temperatures. There is practically no decomposition of the diphenyl, but the high temperatures involved in this process, combined with the characteristics of the heating medium, necessitate the use of special high resistant pipe material. Another feature of this process is that the risk of local overheating of the oil is practically eliminated, thus permitting operation at a high mean temperature level.—*A. E. B.*

For the Amateur Optical Worker

HERETOFORE, such an important adjunct to the physics laboratory as the "optical bench" has been too costly when accurate enough for research work; or if cheap enough for individual experimentation, has been too inaccurate and limited in application to be used for research work.

There have recently appeared advance



Turntable and operating crank for handling seaplanes quickly and efficiently

notices of a new optical bench with which almost every conceivable experiment in optics can be performed, either by individuals or as a classroom demonstration. Accessories are provided for experiments in reflection, refraction, diffraction, polarization, telescopy, microscopy, photography, spectroscopy, and so on.

The usefulness of the bench can be further extended into the fields of photo-electric and thermo-dynamic phenomena by the addition of suitable equipment. Such devices are already designed and under construction and more items will be added to the already extensive list as the demand increases.

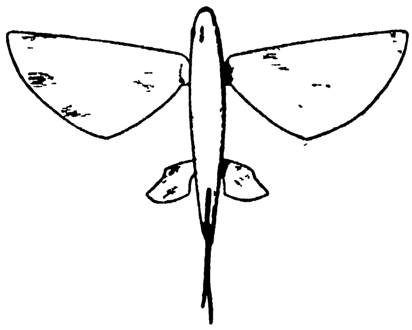
It is pointed out by the manufacturer that a laboratory or individual interested in optical research may make a modest beginning by obtaining the fundamental equipment required for elementary experiments. The more elaborate accessories may be added from time to time.

New Potash Deposits in Chile

DISCOVERY near Antofagasta, Chile, of what are claimed to be inexhaustive deposits of potassium chloride, has been reported to the Department of Commerce. The deposit is said to cover practically the entire bed of a dried-up lake. An area measuring 25 by 75 kilometers has been staked out by interested parties, which comprises less than one third of the area of the lake. The economic marketing of potash from the desert region of the new discovery, which now lacks transportation facilities, will necessitate construction of a railroad.—*A. E. B.*

The Aerodynamics of Flying Fish

THE flying fish is known to the erudite as the *Exocoetus spilopterus*. Found in tropical or sub-tropical regions, it weighs about a pound, is roughly 18 inches in length and with a span of two feet has a wing loading of about two pounds per square foot. The flying fish is far too heavy for the size of its muscles to be able to achieve the flapping flight of a bird and it is difficult to see how it can soar by making use of air currents. Yet both of

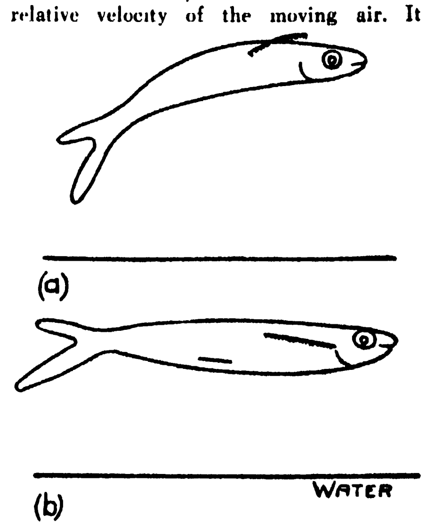


Above: **Top view of the "flight equipment" of a flying fish. *Right, a:* Flying fish, side view, in the act of taking off or ending a flight, and *b,* gliding and losing speed**

these explanations of the flight of the flying fish have been advanced.

C. H. Latimer-Needham, an aeronautical engineer, who has made a hobby of bird and insect flight, advances a much more plausible explanation, writing in the *Sailplane*. The fish attains its maximum water speed in the water and then emerges into the air facing the wind. It therefore has a speed relative to the air of possibly 50 miles per hour. It then glides, just like an airplane, gradually losing speed, and simultaneously bringing down its tail, increasing the angle of incidence, and compensating for loss of speed by increasing the lift coefficient of its pectoral fins or wings. Such is the knowledge of aerodynamics that *Exocoetus spilopterus* has attained that it can cover almost half a mile in the air under favorable conditions.

Mr. Latimer-Needham philosophizes on the theory of evolution: "If we believe in evolution of life, and it is difficult to do otherwise, it is a simple matter to imagine the commencement of fish flight. For instance, if a fish were to leap out of the water, perhaps in an attempt to escape some approaching danger, and found itself facing into a fairly strong wind, then, by simply extending its fins, some measure of support would immediately be felt, due to the relative velocity of the moving air. It



would not be long before the value of such a strategical move was realized by the fish and continued practice for eluding their enemies would result in improvement of the technique till the present state had been reached."—*A. K.*

More Light on Synthetic Rubber

SINCE the announcement of the perfection of a process for making synthetic rubber, chemists of the duPont Company have learned a great deal about this product which has been named DuPrene. They have found that some of its apparent differences from natural rubber are not differences at all, but are due to variations in the compounding of the finished rubber.

"Since the days of Charles Goodyear," say O. M. Hayden and E. H. Krismann, writing in *Industrial and Engineering Chemistry*, "there has been among rubber chemists a growing appreciation of the fact that almost every condition of service to which rubber may be subjected requires a different type of compound, if the best possible results are to be obtained. The most valuable lesson to be learned from the investigations reported here is that this is true of DuPrene to an even greater extent than of rubber. It would be easy for one, who had happened to immerse in sulfuric acid a DuPrene compound containing clay, to draw the conclusion that sulfuric acid causes DuPrene to swell and lose all of its strength and rubber-like characteristics; but, when we have all the facts before us, we see that it is the clay, not the DuPrene, that causes the trouble. Likewise, that very common and generally inoffensive rubber-compounding ingredient, barytes, is one of the worst materials that can be used in a DuPrene stock which is subjected in service to acetic acid, but the mere substitution of clay for the barytes produces a stock that is many times more resistant.

"The art of DuPrene compounding is still young. In the short time that has elapsed since the invention of DuPrene it

Courtesy Caterpillar Tractor Co.

At airports, it is often necessary to remove engines from planes and move them to the repair or maintenance shop. These motors are often large, heavy, and unwieldy and proper handling is somewhat of a problem. One solution is shown: A 650-horsepower engine is being handled by a tractor with portable crane

has been discovered that DuPrene can be compounded so as to make it more resistant than rubber to practically all chemicals. There is every reason to believe that further experience will teach how to impart even greater oil, solvent, and chemical resistance to this unique synthetic rubber." *A. E. B.*

Floodlighted Soap Bubbles

LIGHT, which has been used in many novel ways for display purposes, continues to lend its enchantment at night for decorative adaptations. The latest innovation is the colored floodlighting of a large number of gas-formed soap bubbles as they float up and off through the air.

The arrangement consisted of ten cans about 2 feet deep by 18 inches in diameter

Part of the equipment for producing quantities of soap bubbles

placed in a group in the center of a tennis court. A solution of water, soap, and glycerine was placed in the bottom of each can to a depth of approximately 1½ inches. Experiments showed that castile soap produced the most colorful bubbles, although ordinary soap worked satisfactorily, and that the glycerine strengthened the soap film and made the bubbles last longer. It was also found that better bubbles could be blown in a shallow rather than in a deep solution.

Submerged in the water in each can was a length of half-inch rubber tubing to the end of which a weight was tied to keep the tube under water. These tubes were all connected to an iron manifold having ten outlets, the manifold, in turn, being connected by a rubber hose to the gas supply which, in this case, consisted of compressed hydrogen gas in tanks. This supply was used as a matter of convenience because of the lack of sufficient city illuminating gas where the display was held. When available, city illuminating gas is better for three reasons: First, it is less expensive than hydrogen; second, it is less explosive; and third, it has less buoyancy so that the bubbles do not rise so rapidly through the air, but rather float around in a more leisurely manner, thus making a better display.

Placed on the ground around the cans were three groups of small floodlights equipped with colored cover glasses and 100-watt lamps. These three groups of lights were pointed directly upward so that they illuminated the bubbles up to a height of 20 or 25 feet in the air at which height they were picked up by the beams of the more powerful floodlights.

The more powerful units consisted of colored floodlight projectors located at each end of the tennis court. Each projector was equipped with a cover glass and a 500-watt concentrated-filament floodlight lamp. Glare shields made of strips of Bristol board were placed in front of the projectors to keep stray light out of the eyes of the audience. There was also a screen about 10 feet by 6 feet placed on the windward side of the cans. This allowed large masses of bubbles to form on top of the cans before the wind broke them off and took them floating away.

An interesting variation was made by connecting some of the hoses to ordinary ring-type lawn sprinklers having many small holes in them. This resulted in the forming of large masses of suds rather than the larger iridescent bubbles. As these denser masses of small bubbles floated off through the light they scintillated and sparkled like diamonds.

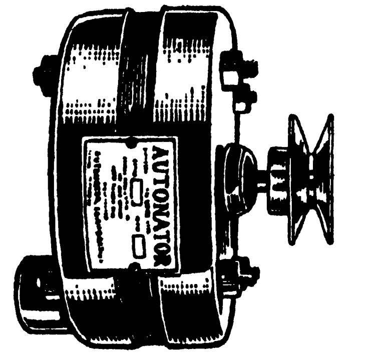
Owing to the explosive nature of the gas, displays of this sort should be handled with as much precaution as would be used with fireworks displays. In this case, as a necessary precaution against possible mishap, the entire tennis court was enclosed with wire netting.

A very good mixture for making bubbles can be obtained by using a 10 percent castile-soap solution (by volume) with about 10 percent glycerine (by volume). The 10 percent soap solution is made by boiling castile soap in water until the solution becomes completely saturated, then using one part of this solution to nine parts of clear water. It was found that 50 cubic centimeters of glycerine added to 1000 cubic centimeters of the 10 percent soap solution produced bubbles two to three inches in diameter which lasted longer than was the case when no glycerine was added. One hundred cubic centimeters of glycerine made the bubbles last from three to four minutes. Increasing the amount of glycerine to 300 cubic centimeters increased the strength of the bubbles to such an extent that groups of them could be picked up by hand without their breaking. The most satisfactory solution was found to be one part of the saturated solution of castile soap, nine parts of water, and one part of glycerine.—*General Electric Review.*

110 Volts A.C. for Automobiles

TAKING no drain from the auto battery and having no brushes, collector rings, commutator, or wire-wound armature to require service, a new device furnishes 110 volts alternating current in automobiles, trucks, buses, airplanes, motor boats, taxicabs, fire trucks, and other motor vehicles. It may also be used as an A.C. power supply for stationary installations to operate from gasoline engines and D.C. motors.

The Autonator, as the device is called, furnishes a satisfactory and economical source of portable alternating current for



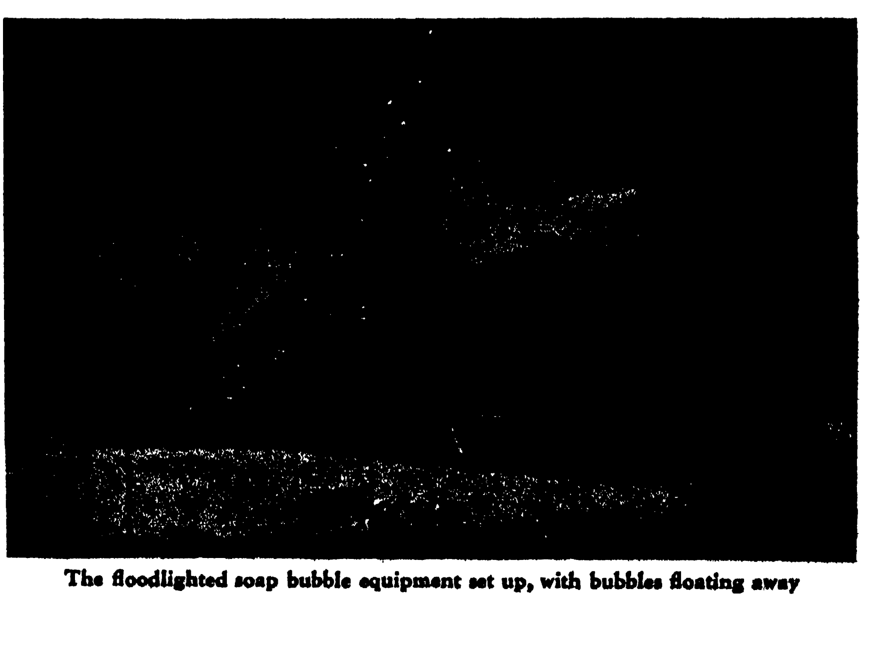
A 110 volt generator for automobiles

operating A.C. radio sets, portable sound trucks and public address systems, neon signs, searchlights, and a multitude of other electrical appliances. It is easily and quickly installed to operate from the fan belt of any motor vehicle, or by direct coupling to a stationary engine. Provision is made for regulation of voltage at all speeds. The generator is available in six sizes -50, 100, 150, 250, 350, and 450 watts.

Why Anemia?

DIFFERENT types of anemia result when the red corpuscles of the blood stop developing at any one of their seven stages of growth in the bone marrow, according to Dr. Raphael Isaacs, assistant director of the Simpson Memorial Institute for Medical Research, University of Michigan.

Using new methods worked out at the Institute for observing how the red blood corpuscles grow in the marrow of the bones of the body, Dr. Isaacs found that there are seven distinct stages before the red corpuscles are sent out fully developed to serve as carriers of oxygen from the lungs to all the tissues of the body. If development stops at any phase, the red corpuscles



The floodlighted soap bubble equipment set up, with bubbles floating away

are retained in the marrow, resulting in a shortage of oxygen carriers.

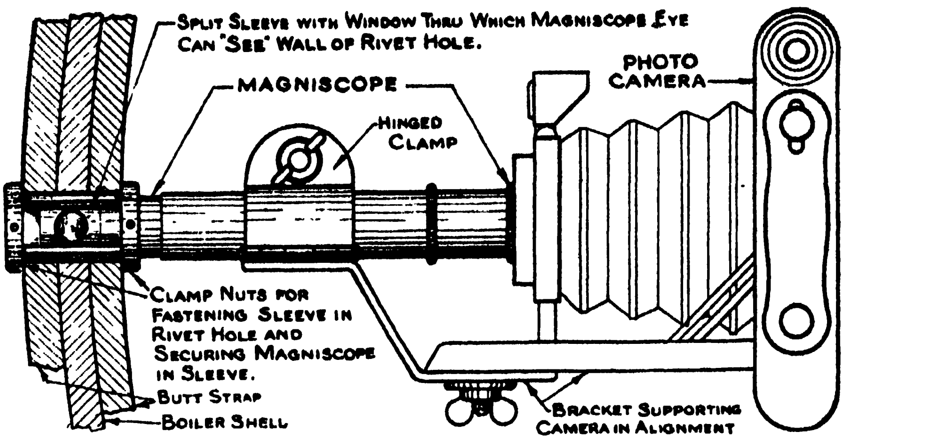
If stoppage of development occurs at the first stage, little in the way of treatment is known as yet. With too few and immature corpuscles in the blood stream, the tissues are starved for the oxygen needed for the complex chemical processes of life. Second stage growth stoppage happens in the disease called pernicious anemia, caused indirectly by the failure of the stomach to manufacture certain secretions needed to stimulate the bone marrow to doing a complete job of corpuscle making. In this case liver or hog stomach extracts will remedy the condition.

Various other less serious anemias, called "secondary," because they may follow or accompany any unhealthy condition of the body which is reflected in temporary disturbances in the functioning of the bone marrow, may occur when red corpuscle development stops at any of the seven stages. A secondary anemia may appear even with growth stoppage at an early state, if the cause of the marrow upset is due to some temporary cause, rather than the permanent secretion deficiency found in pernicious anemia. The secondary anemias of the later stages are controllable by iron preparations, Dr Isaacs stated.

Slow-Motion Movies Reveal Machine Defects

WHEN, as often happens, a machine designed and built on apparently sound and proved principles just doesn't operate correctly, what can be done to determine the cause of failure? In such cases, design experts are now having recourse to the motion picture. They set the machine in motion and take "slow" movies of it as it operates. These movies reveal the behavior of mechanisms moving too rapidly for satisfactory observation by the human eye, and many baffling machine problems have been solved in this manner.

Says R. Fawn Mitchell, manager of the technical department of the Bell & Howell Company: "One of the first instances of securing increased efficiency in machine design by means of motion pictures had to do with a high-speed addressing machine which jammed in the envelope in-feed. A micromotion outfit was arranged to take a close-up of the feeding mechanism with the feeding pawl painted white to facilitate following its motion. Motion pictures taken at 4000 frames per minute disclosed that the feeding pawl vibrated at one time and not at another. Each time the pawl vibrated it failed to feed an envelope. Not only did the pictures show this effect, but they registered the time by means of a high-speed stop watch so that at least a reasonable approximation of the duration of the oscillation could be obtained. With this information the designers were able to effect improvements immediately."



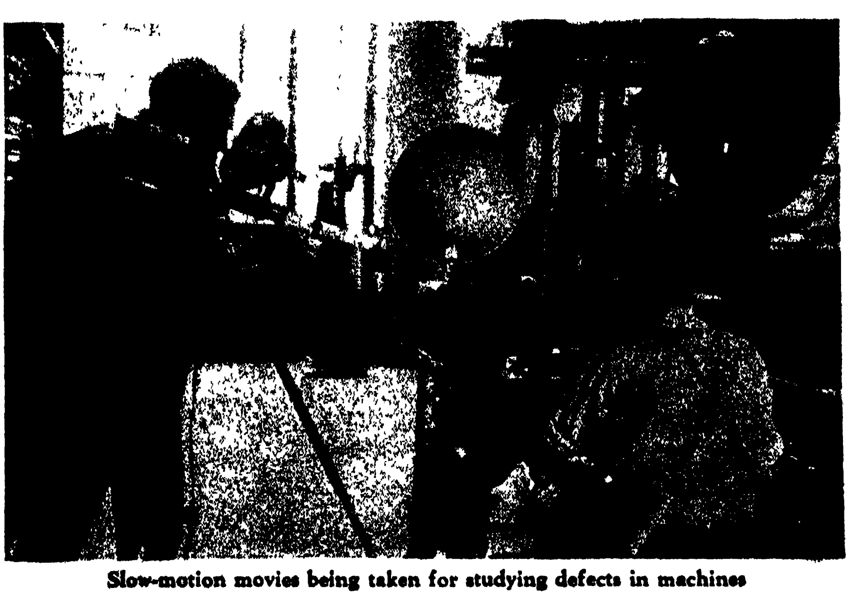
Camera and magniscope for photographing rivet hole cracks

Photographing Rivet Hole Cracks

SEVERAL years ago the Hartford Steam Boiler Inspection and Insurance Company developed what is now known as the Hartford rivet hole magniscope, a sort of magnifying periscope which was described in our columns. This instrument has been found extremely useful in examining the walls of rivet holes for the microscopic indications of embrittlement in its early stages. However, adeptness in focusing the magniscope and in holding it steady while looking through it can be gained only through much practice. In some cases the expert inspector has had difficulty in showing to plant engineers and officials the fissures which, to his experienced eye, were clearly visible.

Recently the company's engineers carried the development of the magniscope a step further, according to *The Locomotive*, by attaching a camera to it. The combined magniscope and camera are clamped into place with the "periscope" section extending into the rivet hole, the camera is focused, and a photomicrograph made of the side wall of the hole. After as many photographs as are necessary have been made of a rivet hole, the expert may then show to plant engineers incontrovertible evidence of any faults or fissures in the steel.

Caustic distress, or fissures caused by disintegration of the binder between steel crystals, is like cancer in its insidious and dangerous growth. If detected in time, however, it may be remedied by simply reaming out the affected rivet holes and driving over-size rivets, thus preventing retirement of the boiler.


Slow-motion movies being taken for studying defects in machines

The Newer Anesthetic

ETHYLENE, which has met much opposition to its use as an anesthetic, seems now to be coming into its own. One of its discoverers, Professor Arno B. Luckhardt of the University of Chicago, speaking at the recent Congress of Anesthetists, pointed out how its value was now being recognized by both medical scientists and patients.

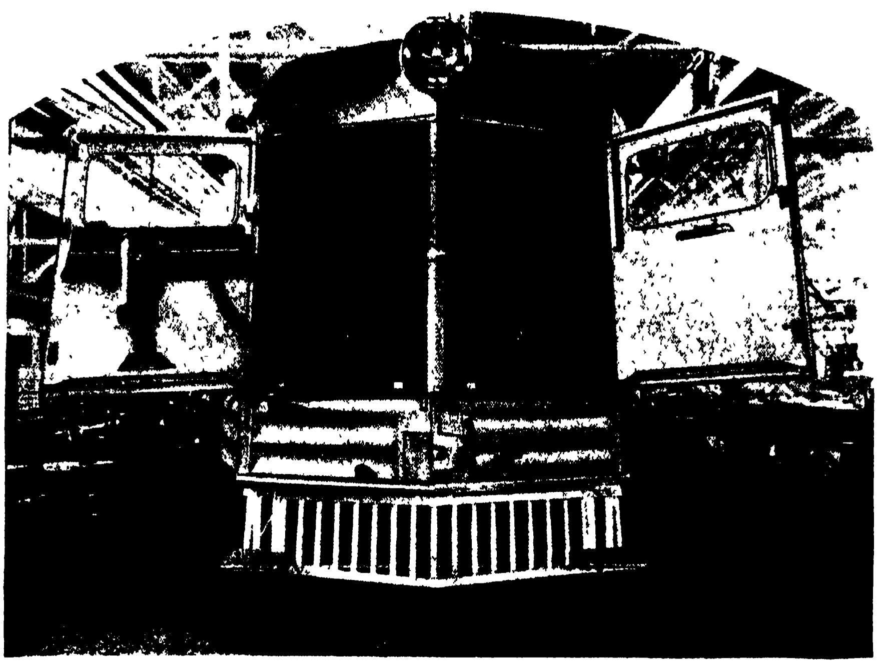
A recent survey of 534 anesthetists showed that 220 of them were using ethylene, and with no explosions recorded. The danger of this anesthetic because of liability to explosion was one of the drawbacks that made it unpopular with surgeons and anesthetists. However, Prof. Luckhardt quoted statistics showing that there was but one death from it in 332,721 cases.—*Science Service.*

Indium

INDIUM, named because of the brilliant blue lines in its spectrum, is now available to the world in commercial quantities. Until quite recently, it was a scientific curiosity in which no one was greatly interested because no one knew of any particular use for it in industry or the arts.

As W. S. Murray points out, in *Industrial and Engineering Chemistry*, element 49 was discovered in 1863 by two German chemists, Reich and Richter, and named "indium" by them. Its isolation was probably made early in its history, but the beginning of its commercial development was left until a few years ago.

Indium plate as it comes from the bath



Front view, with doors open, of new rail-car train, showing gasoline engines

is soft, uniform, and gray. It can be easily diffused into the base metal and thereby hardened. This procedure both hardens and stabilizes the surface so treated, that is, the surface becomes resistant to oxidation and tarnish.

Little has been done with indium outside the field of plating and alloying. However, with a valence of 3, the metal invites the production of many salts and compounds. Since commercial amounts are now available, this element will soon be very much better known to the commercial world.—*A. E. B.*

Another Rail-Car Train

A NEW two-car train represents the advancement made after two years of intensive development on the part of the Budd Company in the application of its "Shotweld" stainless steel construction to rail cars. For the first time it incorporates the economical advantages of light weight, high speed, safety, riding comfort and air-conditioning, even exceeding in these respects the most luxuriously appointed steam trains.

The two units constitute a train of great flexibility. The leading motor car is on two four-wheeled steel-tired power trucks, whereas the trailer, with provision for 76 passengers, is on two eight-wheeled pneumatic-tired trucks. The forward car contains the power plant, consisting of two 240 horsepower 12-cylinder gasoline engines with electric drive, 15-foot railway post-office compartment, and ample baggage space. All of the air-conditioning and refrigerating apparatus is also in this forward car, which leaves the passenger trailer free of any moving mechanism whatsoever and thus provides the utmost in easy riding and silent operation.

Both cars are constructed entirely of "Shotweld" stainless steel and make a striking appearance in their natural bright finish, which requires no painting and but little cleaning maintenance. More heat rays are reflected and those absorbed are diverted by the use of insulating material throughout the roof and sides of both cars.

The top speed is better than 75 miles per hour, acceleration approximately two and one half miles per hour per second. With this performance and 480 horsepower available the train can run some 50 percent faster, and for about half the operating cost of the steam train it will replace in 500 miles daily service on the Texas and Pacific Railway.

Preventing Infantile Paralysis

INFANTILE paralysis attacks children more often than grown-ups because, for one thing, children do not have as good "breathing hygiene" as their elders, according to Dr. W. Lloyd Aycock of Harvard Medical School.

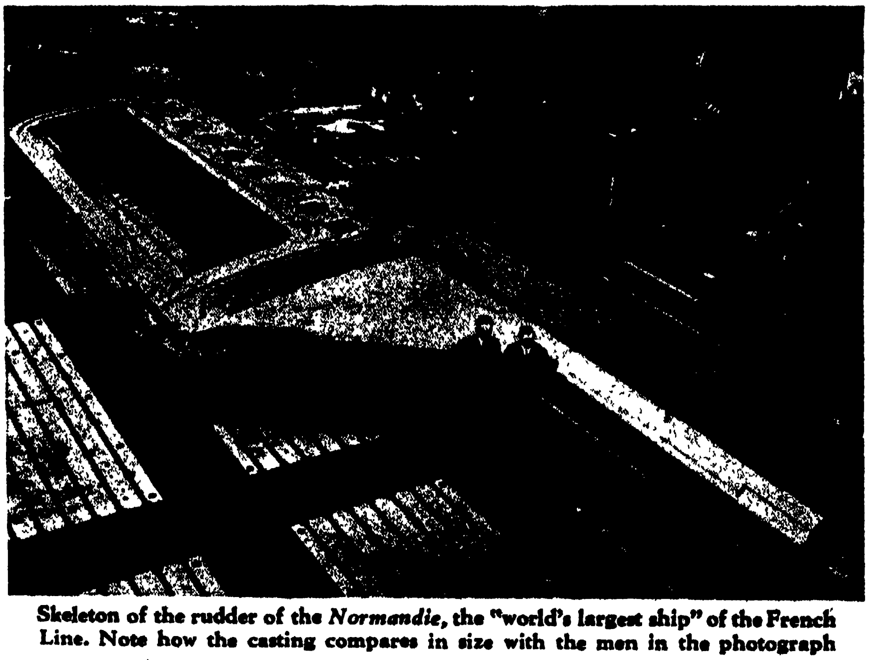
This dreaded scourge of childhood is spread by direct contact, like measles and diphtheria, in Dr. Aycock's opinion. His researches on it, which have been carried on for the past 17 years, lead him to believe that some individuals among both children and adults who are more susceptible get it and others do not. Children who lick each other's lollypops, swap whistles, and borrow handkerchiefs run a much greater risk of picking up the virus that causes the disease than grown-ups who have learned to be more fastidious about personal belongings. The same question of breathing hygiene is responsible for the greater frequency of measles and diphtheria in childhood, he said.—*Science Service.*

Rapid Aging of Liquors

SO many inventors are coming forward with processes for the rapid aging of whiskey, brandy, and rum that a large distilling company is said to have set aside an entire floor of its office building for interviewing applicants who expect the use of their methods to revolutionize the industry. The current number of a luxurious magazine pictures the apparatus with which one company proposes to make 24-hour-aged whiskey, and describes the 2,000,000 dollars "educational" campaign which is contemplated in introducing the article to the public. The idea of rapid aging is by no means new, however, for a 12-hour process for aging whiskey then in use was described in a Government report of over 40 years ago.

Apparently, two principal reactions take place in aging distilled liquors: extraction of flavor and color from oak barrels, and chemical combination of some of the alcohol with the acids extracted from the wood, to make "bouquet." There is probably no reduction of fusel oil on aging, in spite of popular impression to the contrary. In America, the barrels used are charred on the inside, whereas in Europe they are not. This charred wood gives strong color and imparts the distinctly "American" character to the flavor. The smokiness of Scotch whiskey is imparted in a different way: by drying the malt used in the smoke of fires containing smouldering peat.

Wines are aged in wood or glass, for clarification, and for improvement of the bouquet or aroma. The improvement of



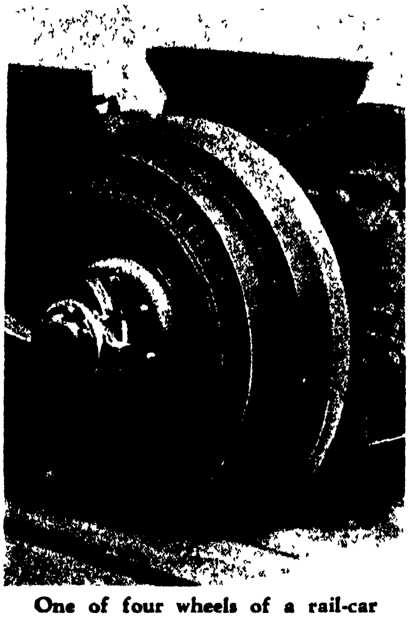
Skeleton of the rudder of the *Normandie,* the "world's largest ship" of the French Line. Note how the casting compares in size with the men in the photograph

aroma is due in no small part to the combination of acids and alcohol (esterification) to make highly fragrant esters. Cider, even the so-called sweet cider, is processed over a period of time, to develop the flavor. Beer, ale, and other brewed drinks must be aged to complete the slow second part of the fermentation, as well as to smooth the flavor.

Knowledge of the changes taking place in materials with age is increasing rapidly. In particular, new reactions are available now that were unknown prior to the prohibition era. Many of these reactions are directed toward offsetting bad effects of aging, although progress in securing benefits from aging is, as these recent developments show, attaining increasing significance.—*Industrial Bulletin* of Arthur D. Little, Inc.

Wheels-On-Air Rail-Car Truck

A NEW four-wheel narrow-gage rail-car truck embodies a number of novel features. The truck frame forms a foundation for the brake rigging and gear. The weight of the car is carried on four outside leaf springs which, through bolsters, transmit the load to the king pin. The load is transmitted to the main frame to both equalizers through a cross-member which has a circular sliding fit in both equalizers. Both equalizers transmit the load to the center or driving axles which are supported by pneumatic tires.



One of four wheels of a rail-car truck using large pneumatic tires

In case of a deflated tire the driving or pneumatic tired axle drops five eighths to three quarters of an inch until the truck frame rests upon the guiding axle, thereby passing the load away from the pneumatic tires to the steel axles and wheels. The car therefore can continue its operation and the tire can be changed at a terminal point.

Due to the combined use of pneumatic tires and flexible running gear a marked improvement in riding qualities is assured. The shock absorbing features of the pneumatic tires make possible a lighter construction of the car as well as the truck itself. The pneumatic tires not only absorb the vertical shocks but the lateral shocks as well. This truck is intended for use on narrow gage railroads but similar trucks have been designed for use on standard gage steam railroads, rapid transit lines, and interurban railroads.

Thallium Improves Photographic Film

COMPOUNDS of thallium are likely to find some use in photography, according to *Chemical Markets*, for it has been found that thallium halide made into an emulsion with silver halide has an important effect upon the properties of the emulsion. In the case of silver iodide the presence of thallium iodide strongly increases the general sensitivity and the chromatic sensitivity.—*A. E. B.*

Monel Metal in Welding

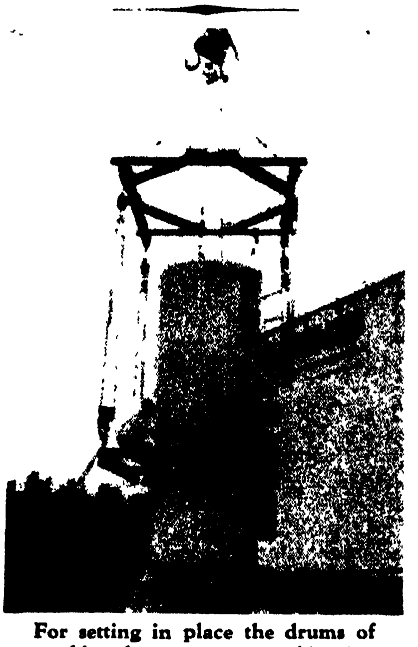
WHEN cast iron is welded with a steel or iron electrode the weld is extremely hard and non-machinable, and the surface can only be finished by grinding. For this reason Monel metal electrodes have been introduced and their use is now being extended, experience having shown that, with proper welding apparatus, they give a surface capable of being machined as readily as the parent metal. The Monel metal rods supplied for the metallic arc welding of cast iron are coated with a special flux, which protects the weld metal from oxidation and fluxes off any oxides which may be formed. Monel metal wire is supplied for oxy-acetylene welding and refined powdered borax is used as a flux. —*A. E. B.*

Pipe "Caravan"

CAMELS cross the desert in Trans-Jordan near the Mediterranean as they did 3000 years ago. Now a new form of transportation comes in competition with them—a pipe line which will transport oil hundreds of miles from the kingdom of Iraq to ports in Palestine and Syria.

This new 12-inch pipe line, 1180 miles in length, taps the rich oil fields near the Tigris and Euphrates Rivers, where petroleum was first used by man.

This pipe line is one of the world's longest and is being built at an estimated cost of 50,000,000 dollars. Many American welding operators, as well as American products, are employed on the project. Welding is being done by the shielded arc process using equipment manufactured by The Lincoln Electric Company.

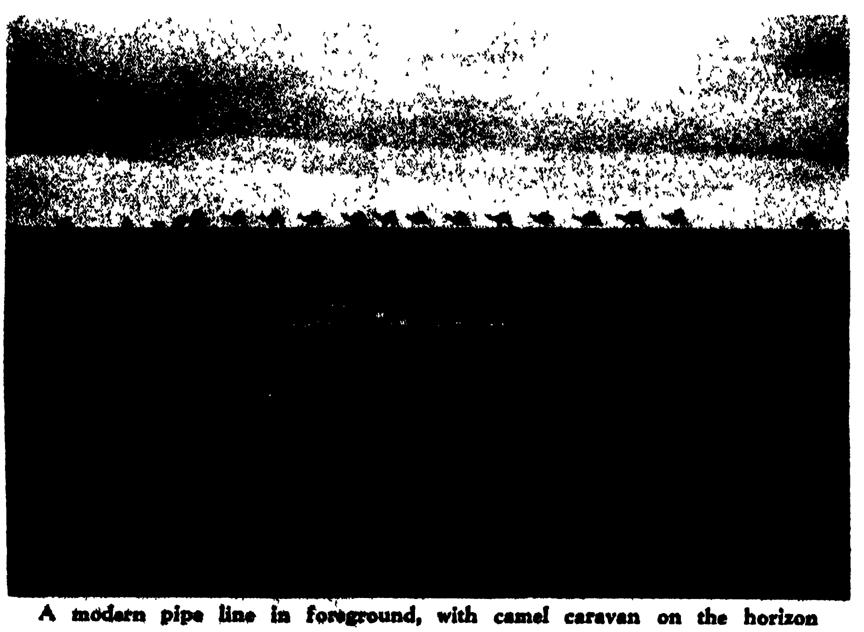


For setting in place the drums of marble columns, a new combination hoist and scaffold has been developed. The scaffold is lifted with the stone when the latter is raised into place. Thus, when the marble is lowered to position, the frame on which men work is within easy reach of the joint. This saves constructing a scaffold for each column

Some Fun for the Mathematically Minded

MR. CHURCHILL EISENHART of Princeton University, contributing editor, in a recent letter mentioned the following mathematical "stunts":

During the past year many of the readers



A modern pipe line in foreground, with camel caravan on the horizon

of this magazine have, no doubt, attended the Century of Progress Exposition at Chicago. While passing the mathematical demonstrations some, perhaps, stopped to look with wonder at the method of determining π, defined as the ratio of the circumference of a circle to its diameter, by a method analogous to throwing matches of length l on a floor where the cracks between the boards represent parallel lines d units apart. In which case, if l is less than d and the experiment be repeated a great number of times (say several hundred), π may be calculated approximately from the relation

$$\pi = \frac{2l}{d} \times \frac{\text{total number of throws}}{\text{number of cases in which matches cross a crack}}$$

This result was originally stated by Buffon in 1801. Since that time many persons have performed the experiment and, in 1901, a century later, Lazzerini made 3408 trials and obtained the value 3.1415929, an error of only 0.0000003.

There is another interesting experiment that may be performed at home with two ordinary packs of cards, and it depends on a theorem given by De Montmort in the early 18th Century. As the more advanced reader knows, there is a number e which is used as the base of Napierian or Natural logarithms. (Briggs or Common logarithms use 10 as a base.) This number e $(= 2.71828)$ has been chosen, since logarithms to this base can be dealt with more easily in the calculus. This e can be calculated approximately with two decks of cards as follows:

Thoroughly shuffle two decks and place them face down on a table, and about one foot apart. Take the top card from each deck and place it face up between the two decks, noting the card in each case. Continue until two *identical* cards appear at the same time. If this experiment be repeated a great number of times, and a record kept of the number of times that *no* coincidence occurred (*i.e.*: entire pack turned up without success), e may be found approximately from the following relation:

$$e = \frac{\text{total cases}}{\text{cases where } no \text{ coincidence occurred}}$$

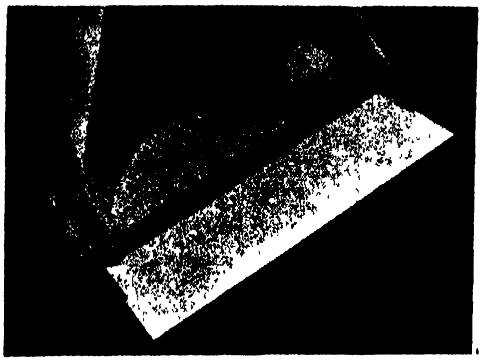
Hence we are able to understand the traditional professor who found it easy to conceive of a race of beings whose fundamental processes of arithmetic and algebra were different from those which appear to us so evident, but utterly impossible to conceive of a universe in which e and π didn't come popping up somewhere.

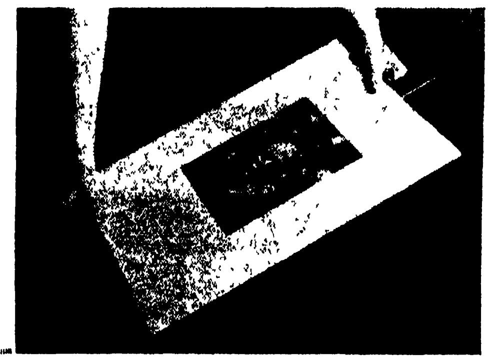
The advanced reader will find the mathematical analysis of these problems in works on Probability, such as J. L. Coolidge, "An Introduction to Mathematical Probability."

Vitamins in Pasteurized Milk

OCCASIONAL statements that pasteurization of milk destroys some of the vitamins in our most nearly perfect food are erroneous, according to Dr. James A. Tobey, writing on this subject in the *Dairy World*. Milk is unique as a food, says Dr. Tobey, because it contains all six of the known vitamins and is an exceptionally good source of two of them, the growth-promoting vitamins A and G.

Of these six vitamins only one, vitamin C, is relatively unstable to heat, and even this is not destroyed by pasteurization but





Adjustable picture frames that may be fitted in a few seconds to pictures within a wide range of sizes are now available. These frames may be hung on any nail, or may be provided with an easel rod. Back and front views of one of these frames being applied are shown above and at the right. The procedure is as follows: The print or photograph is mounted on *(Continued at right above)* **a stiff cardboard mat approximately one eighth inch thick. A piece of plate or window glass is obtained of the same size as the mat and the adjustable frame is then opened and the mat and glass inserted in the channels provided. (See below.) The frame is then closed (left) and locked in place by a simple cam in the rear channel. That is all there is to it. Picture and glass are held firmly**

is merely reduced in amount. The extent of its reduction depends upon such factors as oxidation and catalytic action due to poor condition of the metals used in pasteurizing machinery. Under modern conditions the diminution seldom exceeds 30 percent and may be less. A slight loss in vitamin B may also occur.

Dr. Tobey points out, however, that milk is not depended upon as the main dietary source of either of these vitamins, which are obtained chiefly from citrus fruits and certain vegetables in the case of vitamin C, and from whole grain cereals, yeast, and certain vegetables in the case of vitamin B. These slight losses are, therefore, of no practical significance from the standpoint of human nutrition.

Pasteurized milk is as valuable a food as the best grades of raw milk, according to Dr. Tobey, and has the great advantage of safety, since pasteurization destroys all dangerous bacteria which might be in milk and thus puts the final seal of safety on an already clean milk supply.

Welded Joints X Rayed

WHAT appears to be a large-sized edition of an old-fashioned talking machine is actually one of industry's most modern tools—the completely shock-proof X-ray apparatus which is being used to examine more than 75 miles of welded steel seams in the penstocks of Boulder Dam. Built by the General Electric X-Ray Corporation, the equipment is rated at 300,000 volts and will "look through" four inches of steel. The "megaphone" prevents the spread of the X rays.

X raying the welded joints on a penstock section for Boulder Dam

Chromium Plate Given Clean Health Bill

THE gleaming chromium plate which has been coming rapidly into favor for dishes, eating utensils, and all sorts of restaurant fixtures, has been given a clean bill of health as a perfectly harmless substance to come in contact with human foods, setting at rest any rumors such as the unfounded ones which hampered the use of aluminum utensils when that metal first became popular years ago.

The very thing that makes chromium plate good-looking and easy to clean, its untarnishability, is the reason why it cannot be harmful as a food container. Tarnish means that a metal is being affected by chemicals in the air or in a liquid. To all chemicals found in foods or drinking water, chromium turns a smooth and unaffected cheek. Sulfur, in the air or in food, is the bane of some metals, but chromium resists it perfectly, report Richard Schneidewind, Research Engineer for the University of Michigan Department of Engineering Research, and Dr. Willis S. Peck, of the University Hospital.

Hydrochloric acid is the only thing which will attack chromium in any noticeable degree. Soap and washing alkalis, and natural food acids, even in the heat of cooking, produce next to no effect on it. Water in which a large chromium-plated sample had been immersed for a month was found to have dissolved only five thousandths of a part in a million parts of water. This is much less than most metals would lose, and far below any concentration which could conceivably be considered harmful, they state. To supplement their findings, the investigators polled municipal health officers in all parts of the country and found that none had ever had any reason to blame chromium for ill effects.

Heating and Cooling with Hypo

HYPO, says *Chemistry and You*, makes a good hot water bottle. A bottle filled with melted hypo is corked until you want heat. Take out the cork, rub your finger on the neck, cork again, and heat develops through crystallization. To renew the bottle, put it in hot water until the hypo is re-melted.

In reverse, this process gives a good refrigerant. Put a couple of handfuls of hypo in a bucket of water, when camping, place your ginger ale in the bucket, and it will be made nice and cold—a use discovered by Hollywood laboratory men.

Hypo is also used in bleaching paper and cotton fabrics, to neutralize excess chlorine; in chrome leather tanning, to precipitate chromium; to preserve color and perfume in high-grade soaps; to remove iodine stains from fabrics; and for killing a common fungus that often gets between people's toes and causes itching.

Lately, physicians have found that a solution of hypo injected in the blood is an antidote against cyanide poisoning similar to the famous methylene blue. So this widely useful product may soon be found in the first-aid kit.

"Finger-Printing" New Guns

FEDERAL legislation requiring a trial firing of every gun before sale to the public so that a ballistic impression of its bullet will be on file in every city police department, is advocated by Dr. Wilbur B. Rayton of the Bausch and Lomb scientific bureau, as a method in aiding the swift tracking-down of perpetrators of major crimes in this country.

"This method as applied to tracing the gun and its ownership is similar," Dr. Rayton explained, "to the tracing of an individual through finger-print markings left at the scene of a crime. . . . Thus, by having

on file ballistic impressions of the bullet of every gun before its sale to the public, identification of another bullet from the same weapon used in commission of a crime would be readily available by employing a comparison microscope test."

Selling Cars by Barter

AN Indiana automobile dealer recently accepted as part of the down payment on a new Continental Beacon a two-year-old heifer, 50 bushels of feed corn, 1 bushel of sweet potatoes, 10 geese, and 5 bushels of pop corn.

While farmer incomes in many cases have been renewed and improved so that monthly payments on the essential motor car can be made, not sufficient time has elapsed to enable the farmer to accumulate enough money to make the down payment.

In this case a canny and energetic merchant overcame this obstacle and helped to better trade conditions by accepting some of the farmer's assets in lieu of cash for the down payment.

When Southerners Go North . . .

SOUTHERNERS who migrate to the North are more susceptible than northerners to arteriosclerosis, familiarly known as hardening of the arteries, in the opinion of Dr. Clarence A. Mills of the University of Cincinnati. Calling arteriosclerosis the "greatest of our degenerative diseases," Dr. Mills said that "these southern migrants die at a much earlier age from this cause than do native northerners and also earlier than their fellowmen who remain at home in the South."

"The great influx of southerners, both white and colored, into the manufacturing cities of the North during the last 15 years has presented us some important health problems quite aside from those of sanitation and personal hygiene," he stated.

"In the free clinics of Cincinnati, where thousands of these people are seen in states of bodily and nervous exhaustion, it is evident that a major problem in public health is being presented. Not only are these migrants found more susceptible to acute respiratory diseases such as pneumonia, sinusitis and colds, but they also show frequent metabolic disturbances. Toxic goiter and diabetes seem to attack them even more than they do native northerners. Various types of asthenia [weakness] with nervous exhaustion are also particularly common among them."—*Science Service.*

. . . And Northerners Go South

PATIENTS suffering from inflammatory rheumatism and heart disease may be benefited by a tropical climate, it appears from a discussion of the advantages of cure resorts in the tropics presented by Drs. Louis Faugeres Bishop and Louis Faugeres Bishop, Jr., of New York City, at a meeting of the American Society of Tropical Medicine.

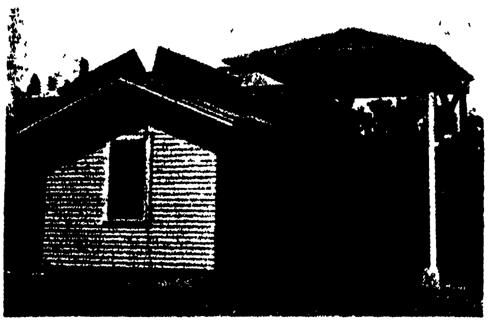
"We know that climate has a profound influence on the lives of those who enjoy its advantages, but one of the most striking facts in connection with climate is that it is not only the climate itself we look to for benefit, but equally important is change of climate at the right time," Dr. Bishop

(Please turn to page 49)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

AMATEUR telescope making activities continue unabated among our readers. Here, for example, is a summary of the activities of the Pittsburgh group of amateurs, sent in by Leo J. Scanlon, their local patron saint and secretary-treasurer. Six-inch reflectors: Under construction, 64; completed, 34. Eight to nine-inch reflectors: Under construction, two; completed, six. Ten-inch reflectors: Under construction, six; completed, four. Twelve-inch reflectors: Under construction, five; completed, four. Total under construction, 77; completed, 48.



A neat observatory built by John Bunyan, president of the Berthoud National Bank, Berthoud, Colorado. Main room at rear, for a ten-inch Cassegrainian—roof rolls off on track. The small room at nearer end houses a meridian telescope

We showed this summary to Wally Everest, patron saint and president of the Pittsfield, Massachusetts, group (The Berkshire Astronomical Association), who came right back at us with a tabulation showing 20 telescopes completed, also nine unmounted mirrors made, two being made and six ordered. Of these, 14 were of Pyrex and one of fused quartz. Everest goes on to demonstrate by abstruse mathematics that, since Pittsburgh's population is 600,000 and Pittsfield's is only 50,000, each Pittsburgher makes .000208 of a telescope and each Pittsfielder .000740, or 3.55 times as many. Learning of this body blow, Scanlon retaliates in red ink that his listing did *not* count mirrors merely ordered and others as yet unmounted.

Well, anyway, there's a lot of activity in Pittsburgh and in Pittsfield too. The Pittsfield group is made up entirely of employees of the General Electric Company.

NOW comes Buffalo with a new group, the Amateur Telescope Makers of Buffalo, with 15 charter members. Thaddeus Czerniejewski, 113 Franklin Street, Lackawanna, New York, is its chairman.

Winston Juengst of Todd Union, University of Rochester, Rochester, New York, mentions the organization of an Astronomy Club in that city, which is doing meteor research and making telescopes as well.

Here is a short bit of comment which we have had in our system for a long time and wanted to get rid of: Amateur telescope makers frequently inquire regarding the relation between quality and price in telescope making supplies. It stands to reason that, on the whole, *price reflects quality*. There may be partial exceptions to this—for example, sometimes when the dealer is his own manufacturer—but there are probably few fields in which materials which look about alike, and *can be described about alike* without risk of imprisonment, may vary so widely in real quality. There may be more qualities pertaining to a prism, for example, than its dimensions. Buyers seldom get something for nothing.

HERE is an interesting tabulation made by Professor Lundmark of Sweden, and taken from *Journal of the British Astronomical Association*. The number of permanent observatories in each country: U.S.A. 80, Germany 34, Italy 21, Great Britain and Ireland 26, France 14, Russia 14, Poland 10. The number of astronomers: U.S.A. 407, Russia 182, Germany 165, France 100, Great Britain 103, Japan 72. But Switzerland, with over 9 astronomers per million, has the greatest percentage of astronomers (we recall that the same nation has the highest percentage of inventors). Denmark has 8. New Zealand, Australia, Austria and Esthonia rank high. England and the U.S.A. have less than 4 per million. The largest astronomical society is the Société Astronomique de France (no figure given, but we think it is 5000); British Astronomical Association, 2000. The societies in Kyoto and Budapest come next. There are over 368 astronomical publications in the world. Most of these are of a very specialized nature.

***Above and at right:* Observatory and 12-inch telescope built by K. F. Davison, professional photographer, Marshfield, Wisc.**

So many have inquired about the new method of plating mirrors by evaporation in a vacuum that we have fished out the *Astrophysical Journal* for last June, which contained a five-page article on the technique, by Robley C. Williams and George E. Sabine of the Department of Physics at Cornell University (Ithaca, New York). The work requires a steel bed-plate, a glass bell-jar and a high-vacuum pumping system. The bed-plate used was 22 inches square, but this depends upon the diameter of the mirror. Glass plugs containing tungsten leads must be sealed into holes in the plate. The metal to be evaporated and deposited is heated electrically by a filament and the mirror is placed about three inches distant from it. The bell-jar placed over the whole apparatus must have a very tight joint at the bottom where it meets the bed-plate. A vacuum of one thousandth of a millimeter of mercury is required, and this demands a better vacuum pump than most amateurs have available.

Coating a 16-inch mirror requires 15 minutes. Chromium or aluminum may be applied. The latter has excellent reflectivities—90 percent in the yellow and 80 percent in the violet. Similar work has been done with magnesium, by Hiram W. Edwards of the University of California (Berkeley). Two years ago, Professor John Strong of the California Institute of Technology (Pasadena) sent us a description of his method, and tried to work up a simplification for the amateur telescope maker, but he later stated that the high vacuum would offer too great an obstacle for the amateur unless he had access to better than average laboratory equipment. It is believed that several amateurs so situated have experimented with this method, but the outline above is given mainly in order to show that it is probably out of the reach of the average worker. It is too complicated and too expensive.

A six-inch Cassegrain by Alan R. Kirkham of Tacoma, with prism

A STUNT for silvering, sent in by Lincoln K. Davis of Campello Station, Brockton, Mass., is as follows: "Get a paper pie plate, preferably the kind made of heavy, coarse pulp, with a bottom diameter about the same as that of the mirror to be silvered. Place the mirror inside, and mark around it with a sharp pencil. Then cut out the bottom on this line, or slightly inside, and the result will be a collar which can be fitted around the mirror near the top. A soaking with shellac, pitch, or paraffin makes it tight and acid-proof. A heavy rubber band immediately beneath it helps to locate it and makes the mirror easier to handle."

Frequent inquiries received indicate a desire on the part of many beginners to build up mirror disks from lamina of thin glass. There is a big gamble in this. Doliver S. White, 232 South Main Street, Mansfield, Massachusetts, with Leon G. S. Wood, made an 8-inch disk from four pieces of quarter-inch plate cemented with Rutland water glass. The mirror performed nicely but, in Mr. White's language, "after using the telescope for some days we discovered that the mirror was losing its figure. Immediately we tested it and discovered that the curve had radically changed. The curve was so distorted that we fine ground it and figured it again. Again the mirror gave what to us seemed a perfect performance, repeating its former performance. We have found, however, that the mirror cannot be depended upon to keep its figure more than a few days at the most. In consideration of our experiences we would not advise the use of this type of mirror.

"If any of the readers of the SCIENTIFIC AMERICAN would like a more detailed account of how we built a mirror that worked at no expense except for the chemicals used for the silvering process, we shall be very glad to hear from them."

Mr. White did not reveal the nature of the latter mirror in his letter.

We often hear of short cuts in polishing—mirrors polished in one or two hours, and so on. Here is what J. W. Fecker, the professional, has to say about this: "The amateurs and all the rest who have not already done so must depart from the belief that there is a quick way to obtain an optical surface. An optical surface is nothing less than a work of art and there is no short cut to results." No doubt some will regard this as a challenge, but . . .

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

The Editor will appreciate it if you will mention SCIENTIFIC AMERICAN *when requesting any of these bulletins*

SUGGESTIONS FOR PHEASANT MANAGEMENT IN SOUTHERN MICHIGAN, by Howard M. Wight, gives suggestions that are intended to guide farmers and other landowners who wish to increase the supply of pheasants and incidentally of other wild life. The cost of producing pheasants by the method described is only 47 cents per bird in comparison with the usual artificial propagation cost of from two dollars to three dollars a bird. *Department of Conservation, Lansing, Michigan.—Gratis.*

ZINC describes many uses of that metal; for example, zinc die castings and rolled zinc may be used for 53 parts of an automobile. This pamphlet gives a good picture of the uses of zinc and its alloys. *New Jersey Zinc Company, 160 Front St., New York City.—Gratis.*

AIR CONDITIONING FOR HEALTH, COMFORT AND PROFIT. Hot weather may be converted into a business asset by moving picture house owners, merchants, and restaurant keepers. The uses of this comparatively new addition to our modern life are fully described in this pamphlet. *Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.—Gratis.*

AZIMUTH DETERMINATION (Engineering Experiment Station, Bulletin No. 79), by E. F. Coddington, Professor of Geodetic Engineering, Ohio State University. This booklet represents an attempt to write a manual on azimuth which will eliminate the mystery usually associated with this subject. A chapter on astronomy has been included in order that the reader may familiarize himself with the concepts involved. The sun and Polaris are the natural objects most often used in the determination of the true north. *Ohio State University, Columbus, Ohio.—50 cents.*

BAKELITE REVIEW (October, 1933, Volume V. No. 3) describes Bakelite resinoid which is a material of a thousand uses; for example, it goes into pipe stems, umbrella handles, the handle of your percolator, the casing of your refrigerator, and the cabinet of your radio. *Bakelite Corporation, 247 Park Avenue, New York City.—Gratis.*

THE CHANGE FROM MANUAL TO DIAL OPERATION IN THE TELEPHONE INDUSTRY (Bulletin of the Women's Bureau No. 110, U. S. Department of Labor) describes the effects of a mechanical device on an industry. Practically the only operators laid off at the final cut-over were temporary workers engaged only for a few months. This is a notable example of the possibilities of long-view planning in cases of technologic change. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

WATER POWER EQUIPMENT describes a new field (commencing in 1921) of a well established shipbuilding company. They have built turbines, butterfly valves, and trash-rakes for hydro-electric power plants, as well as other necessary equipment. The company maintains a well-appointed hydraulic laboratory. The pamphlet is beautifully illustrated and naturally can be sent only to interested parties. *Newport News Shipbuilding and Drydock Company, 90 Broad St., New York City.—Gratis.*

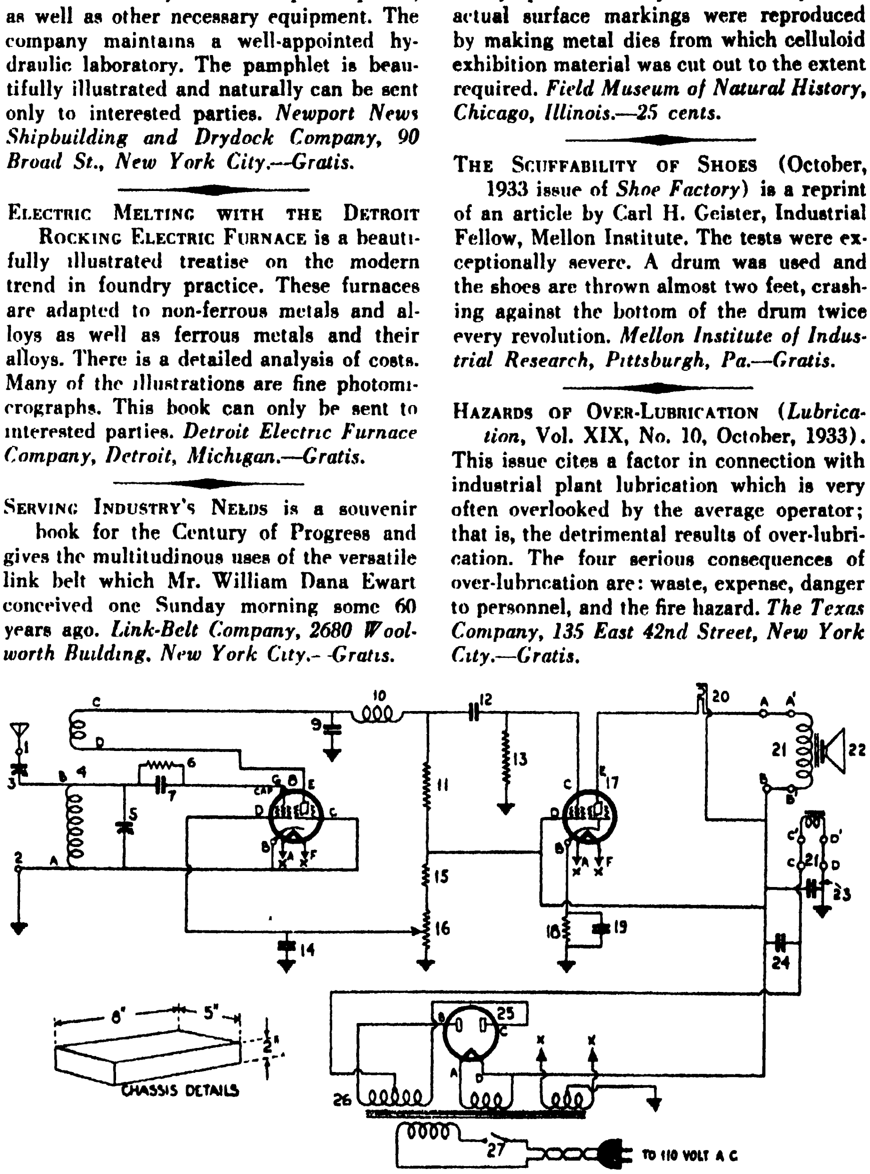
ELECTRIC MELTING WITH THE DETROIT ROCKING ELECTRIC FURNACE is a beautifully illustrated treatise on the modern trend in foundry practice. These furnaces are adapted to non-ferrous metals and alloys as well as ferrous metals and their alloys. There is a detailed analysis of costs. Many of the illustrations are fine photomicrographs. This book can only be sent to interested parties. *Detroit Electric Furnace Company, Detroit, Michigan.—Gratis.*

SERVING INDUSTRY'S NEEDS is a souvenir book for the Century of Progress and gives the multitudinous uses of the versatile link belt which Mr. William Dana Ewart conceived one Sunday morning some 60 years ago. *Link-Belt Company, 2680 Woolworth Building, New York City.—Gratis.*

A FOREST OF THE COAL AGE (Geology Leaflet 14, Field Museum), by B. E. Dahlgren, describes a most remarkable exhibit in the Museum, which has been recently opened to the public. In many cases actual surface markings were reproduced by making metal dies from which celluloid exhibition material was cut out to the extent required. *Field Museum of Natural History, Chicago, Illinois.—25 cents.*

THE SCUFFABILITY OF SHOES (October, 1933 issue of *Shoe Factory*) is a reprint of an article by Carl H. Geister, Industrial Fellow, Mellon Institute. The tests were exceptionally severe. A drum was used and the shoes are thrown almost two feet, crashing against the bottom of the drum twice every revolution. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

HAZARDS OF OVER-LUBRICATION (*Lubrication*, Vol. XIX, No. 10, October, 1933). This issue cites a factor in connection with industrial plant lubrication which is very often overlooked by the average operator; that is, the detrimental results of over-lubrication. The four serious consequences of over-lubrication are: waste, expense, danger to personnel, and the fire hazard. *The Texas Company, 135 East 42nd Street, New York City.—Gratis.*



The three-tube A.C. operated Find-All Globe-Trotter covers the short-wave band from 15 to 200 meters. Through the use of a special broadcast coil, this same receiver can also be used to cover the standard broadcast band from 200 to 550 meters. This set has plenty of power, giving loud speaker operation on many stations, and is sensitive and selective. Using comparatively few parts, it is easy to build and simple to operate. The circuit utilizes a 57 high gain r.f. amplifier pentode as a regenerative detector and the powerful new 2A5 pentode as the power output tube. A small Hammarlund midget condenser controls antenna capacity and makes an excellent vernier. Plug-in coils are of the Alden four-prong type. Regeneration is controlled by means of an Electrad potentiometer which varies the voltage applied to the screen grid of the 57 tube. This takes the set into and out of regeneration with extreme smoothness. Additional diagrams and views, complete list of parts, and other information regarding this receiver may be obtained from *Allied Engineering Institute, Suite 542, 98 Park Place, New York, N. Y.—10 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 45*)

pointed out. He suggested that a tropical climate should be available for physicians to order for their patients and that eventually it may be possible to determine by experiment the climate best suited to each person.

The absence of inflammatory rheumatism in the tropics, testified to by many observers, prompted Dr. Bishop's interest in the health advantages of a tropical climate. He thinks it should be tested for young people with progressive rheumatic heart disease and for elderly people with disease of the heart of the degenerative type. Many of the drawbacks of the tropics can be mitigated with modern air conditioning.

"The climate of the tropics promotes all those things which are needed in heart disease," said Dr. Bishop. "It promotes distaste for physical exercise. It is a notable fact that many heart patients who go to the tropics to pass their remaining days find those days very much longer than anybody expected."—*Science Service.*

A courtesy signal for motorists. Of English design and manufacture, this signal is used to acknowledge the courtesy of another motorist when he gives the right-of-way to a passing car. The device, electrically lighted, is shown mounted on the left because of English traffic laws

Will Civilization Starve Itself?

OUR machine age will eventually starve itself to extinction by its insatiable appetite for raw materials which will eventually be exhausted, according to an opinion of Prof. R. A. Gortner of the University of Minnesota, expressed before the American Association for the Advancement of Science. Professor Gortner points out that irreplaceable natural resources absolutely essential to modern industrial civilization are disappearing into the "maws of indus-

try" and so wastefully dissipated over the earth. The shelves in some of Nature's cupboards are showing signs of exhaustion of the materials necessary for a mechanical age.

In particular, Professor Gortner mentions the approaching exhaustion of copper, antimony, tin, lead, zinc, chromium, manganese, nickel, and iron, which are stored in parts of the earth accessible to man. The rate of use of some of these metals is doubling each decade. We still use tin-foil for wrapping up sweets and cigarettes. At the present mining rates, iron will be exhausted in Germany in about 50 years and in the United States in 100 years. The United States sulfur supply will fail in 15 years; the coal of Germany in less than 1000 years and of the United States, notwithstanding its huge lignite deposits, in less than 1500 years. Professor Gortner fears that the machine age may starve to death before long, a victim of today's profligate use of metals, coal, and oil.

No chemist will lose sleep over the dismal prospect that Professor Gortner visualizes. The chemist is sublimely confident that long before the petroleum wells are dry, he will be able to produce synthetic substitutes for all the petroleum products essential to the machine age. He can readily imagine a day when the iron that Professor Gortner is worrying about will lie undisturbed in its subterranean solitude because new and better metals will have made it worthless. It requires but little imagination for the chemist to foresee the time when unlimited power will be available from atomic energy and when sulfur or coal or tin will be made from mud or air or what-have-you by a rearrangement of the internal structure of the atom.

Wild imagination? Perhaps. But since we're speculating in the realm of the distant future, why not enjoy the chemist's optimistic outlook instead of the dreary forecast of a starved civilization? One is probably as close to the truth as the other. *—A. E. B.*

Lens for Eyes Having Cataracts

A LENS development, said to be capable in many instances of restoring to the cataract patient, following operation, near and distant visionary power equal to or better than normal vision, was made known recently by Scott Sterling, scientist of the Bausch and Lomb Optical Company, in announcing perfection of a new type of cataract lens with increased index power and having a thickness only one half that previously employed.

In appearance, Mr. Sterling reported, the new lens is hardly distinguishable from an ordinary lens of low power.

The new development is described as a combination of two lenses designed upon the principle of the bi-focal wherein a small, or seeing lens, is fused within a larger one. By use of this mechanical principle, the original power has been retained while allowing, at the same time, for reduction in over-all thickness of the combination lens to about one half the average size—in actual measurement to approximately ⅛ of an inch in thickness. In addition, the index power of the lens has been increased by use of Nokrome, an improved precision glass free from all color.

In grinding operations, the inside sur-

face of the new lens is made to the individual's prescription just as always, but the front surface consists of the inlaid or primary lens with its high index of refraction.

40,000,000,000 Germs in Pound of Earth

INSTEAD of being inert and dead, ordinary farm land is teeming with life. Cultivated soils have anywhere from a few million to five billion bacteria in a pound of top-soil; under certain favorable conditions the germ population per pound may run as high as 40,000,000,000, according to a statement of the Service Division of The American Agricultural Chemical Company. These organisms are very small, consisting of single cells only one twenty-five thousandth of an inch in diameter. They are the lowest form of plant life and contain no chlorophyll, the green coloring matter which enables ordinary plants to produce substances suitable for the support of animal and human life.

Most important of the work of bacteria is the formation of humus. The oxidation of the carbon in the organic matter provides carbon dioxide for plants. The microorganisms create many complex substances, some of which make the mineral matter in the soil more soluble, and thus more available for plant life. Some of these bacteria break down the complex protein material of dead vegetable matter and convert it into soluble nitrogenous substances which can be used by living plants. The growth of such bacteria requires oxygen, and for this reason tillage of the soil promotes their growth. There are other bacteria which change back the nitrogenous compounds suitable for plant life into unavailable substances. Such undesirable bacteria grow best in soil which lacks air and is poorly drained. Under ordinary soil conditions they have little effect on crops.

Farmers may increase the usefulness of bacteria in the soil by adopting methods of cultivation and soil treatment which favor their development. Plowing under of organic matter so that the bacteria can make humus, rotation of crops to include legumes on which nitrifying bacteria thrive, draining of wet lands, the adding of limestone to acid soils, and the use of fertilizers are recommended.

Art of Making Soap Revived

LAST year witnessed a noticeable revival of soap making on farms, reports the Extension Service of the United States Department of Agriculture.

Farm housewives in some sections of the country have made a little soap now and then as a matter of economy, but this old household art had, until recently, almost disappeared in many sections.

A report to the department from South Dakota shows what can be saved by making soap at home. In 1932 farm families in 27 counties in that state reported making soap under the guidance of extension agents. Valuing laundry soap at six cents a pound, the soap made in these counties last year was worth more than 2500 dollars.

In Oklahoma, Illinois, Iowa, Missouri, Minnesota, Colorado, Wyoming, Oregon, Washington, Wisconsin, and other states, home demonstration agents have encour-

aged soap making on the farm as one of the ways to avoid cash outlay and make use of a farm waste. County home demonstration agents can usually supply instructions for making soap at home.

Prevents Rancidity of Olive Oil

OLIVE oil has long been held in esteem for treating textiles, but under certain circumstances it may become rancid. This causes trouble because in that condition it becomes difficult to remove, may interfere with dyeing, and imparts a disagreeable odor to the finished goods.

Chemists of the National Oil Products Company, after a thorough study of the complex chemical reactions involved in this process and hundreds of experiments with olive oil treated in various ways, finally hit upon a method of treating the oil which eliminates rancidity as a practical consideration. Goods treated with this new material failed to develop rancid odors even after storage for a year.—*A. E. B.*

The Electric Nose

AN "electric nose" so sensitive to the "smell" of mercury that the faint whiff arising when the cork of a mercury container is held against the "nostril" will sound a gong, has been developed by the General Electric Company. The detector will act if there is only one part of mercury vapor in a hundred million parts of atmosphere. The most sensitive previous type of mercury detector would give warning of one part of mercury in thirty million parts of atmosphere, so that the new apparatus is

The electric nose "smelling" the cork from a container of mercury

three times more sensitive than the old. Also it is much faster, responding in a few seconds, whereas the previous detector operates only after some minutes have elapsed.

When in operation, the new detector "smells" through an internal "nostril" or intake duct, which draws in flue gases from the stack of a mercury boiler. The gases are given a preliminary treatment to remove stack impurities which would nullify the work of the detecting mechanism. The gases then pass through an ultraviolet beam from a mercury light source

and of a wavelength known as the resonance radiation of the mercury atom. This radiation is directed to a quartz-sodium phototube, which, unlike the usual type of "electric eye," is supersensitive to a beam of this character. Mercury vapor is opaque to this light and casts a shadow, just as smoke is opaque to ordinary light and casts a shadow when in such light.

The weakening of the ultra-violet ray, when mercury vapor is present, instantly causes a small change in an electric current inside the tube, which, amplified by other tubes, operates the circuits, giving warning of the leak of mercury by means of a red light and a gong.—*A. E. B.*

Perfume Research Gives Deadly Gas

By accident, rather than by design, a research chemist of France, Professor Leonce Bert, has discovered a gas which is said to be far more deadly than any other gas used in warfare. The formula was discovered while Professor Bert was endeavoring to work out a perfume preparation.

Due to the fact that this new gas, according to reports, is irritating not only to the eyes and lungs but to all parts of the body as well, it is said that a gas mask will be of no avail against it. Tried on the skin of a dog, death of the animal resulted in a matter of a few hours.

So far no details as to its analysis are available but it is said to be comparable with true cellular poisons.

Improved Sheet Iron

An entirely new form of an old metal—iron—is believed by its sponsors to promise a superior material for the fabrication of automobile bodies and other metal specialties. Anson H. Hayes, director of the research laboratories of the American Rolling Mill Company, reports the development of a deep-drawing sheet metal which "has physical properties new to ferrous metals and of great importance to the metal stamping world." Commercial production will soon be started.

It is claimed that the metal can be drawn and spun with facility, permitting manufacturers of pressed metal products to produce most intricate designs. The metal has great ductility and tensile strength, and tempering does not destroy its drawing qualities.—*A. E. B.*

Russet Oranges Inferior

Contrary to common belief, russet oranges are not sweeter than bright ones. In fact, they have a higher acid content, according to the results of analyses recently made in the United States Department of Agriculture. The analyses showed further that russet fruit loses weight more rapidly than bright fruit.

Russet oranges, Department entomologists explain, owe their color to the activity of the rust mite, a tiny creature that works on the skin of the fruit in its early stages. The mite does not penetrate into the flesh; it leaves its mark only on the rind. Apparently, however, the attack of this insect increases the rate of evaporation of fruit juice. As a result, russet oranges are usually smaller than bright oranges and their juice is more acid.

Books SELECTED BY THE EDITORS

THE DRAMA OF WEATHER

By Sir Napier Shaw

THIS book is the selection of the Scientific Book Club and will have a wide popular appeal. It is a successful attempt to dramatize the rhythm of the weather, evidently in order that readers who dislike their pills unsugarcoated may without effort pick up some weather lore as they pass. It is not a meaty book, being rather more on the superficial side of just serious enough for the scientifically inclined layman. However, the reader will gain an insight into the ways of the winds and other elements, also a glimpse of the instruments used by weather observers. This book is beautifully produced, richly illustrated, and printed on fine filled paper. It is recommended for the general reader, not the student.—$3.65 postpaid.—*A. G. I.*

THE BEAGLE DIARY

By Charles Darwin

AFTER all these years Darwin's famous "Voyage of the Beagle," in which he recorded day by day the vivid impressions of his formative years while on his famous voyage (1831-1836) around the world in quest of new data on natural history, has been re-published in expanded form. In all of the earlier editions one third of the diary was omitted. Darwin's granddaughter, Nora Barlow, has now added the omitted parts, taking them from the original manuscript notes. This is a neater edition than any previous—nice type, paper, printing, and binding. 442 pages, 6½ by 9½.—$6.70 postpaid.—*A. G. I.*

THE PRIVATE LIFE OF SHERLOCK HOLMES

By Vincent Starrett

EVERYONE who has read any or all of Doyle's stories about the famous detective of Baker Street will want to read Mr. Starrett's critical survey of the life of Holmes. In these pages both Holmes and Watson are subjected to a careful analysis and their faults and foibles are placed side by side with their admirable qualities. Poor Watson's memory is so often called to task that one wonders how he managed to function at all! If you think you know your Sherlock Holmes, consult the "Examination Papers on Sherlock Holmes" in the appendix of Mr. Starrett's book and we will wager that you will soon be refreshing your own memory in the pages of Doyle's stories. This reviewer found himself reading "The Private Life" with a complete set of the Holmes stories at his elbow for ready reference.—$2.15 postpaid. For $4.00, we can supply, postpaid, a two volume set, "The Complete Sherlock Holmes," containing all the stories of the famous detective by Doyle, nicely printed on thin paper and published as a memorial edition just after Doyle's death.—*A. P. P.*

PERSONS ONE AND THREE

By Shepard I. Franz, Prof. Psych., Univ. of Calif.

THERE is human interest as well as science in this book, which is a narrative account of the experiences of a man who forgot who he was. By digging deeply into this amnesic's subconscious, Professor Franz, the author, found that he had been one man ("Person One") until some emotional disturbance during the World War had utterly changed his personality ("Person Three"), and then had lived ten years in this country without memory of Person One. Suddenly in 1929 he slipped back into Person One, but at the same time forgot everything in his ten years as Person Three. The author was able to connect these personalities and memories, restoring the man to normal condition. The account—188 pages—makes fascinating reading.—$2.15 postpaid.—*A. G. I.*

HOUSEHOLD REFRIGERATION

By H. B. Hull, M. E.

HOUSEHOLD refrigeration has undergone such a profound revolution that it is little wonder that four editions of this book have been called for in nine years. Sixteen new refrigerants are described and there is a chapter on air conditioning. This is a thoroughly scientific book written by a refrigerating engineer. All the various types of household refrigerators of any prominence are described in detail. A new chapter is included on commercial refrigeration in which requirements and equipment for many lines of business are discussed in detail, with many illustrations of equipment. The subject of testing is treated in a different manner than in the previous editions. A valuable reference book for all connected with the industry; filled with tables and containing 278 illustrations.—Cloth $4.25 prepaid; morocco $5.25 postpaid.—*A. A. H.*

SCIENCE AND SANITY

By Alfred Korzybski

READERS who possess a broad and deep background in philosophy, psychology, epistemology, logic, and the other existing fundamentals of knowledge, and are prepared to put on a heavy thinking cap, will find in this book a great deal to think about. The profundity and erudition displayed in it have been widely recognized among leading men of science and others who themselves think more profoundly than the rest of us. It concerns largely the very roots of human knowledge, and shows why much of our failure to progress as fast as we might is because our thinking is itself bad. It presents a plan for radical revamping of our whole theory and practice. This work deals with the very fundamentals and is distinctly not a superficial book—quite the reverse. 781 pages.—$7.20 postpaid.—*A. G. I.*

REPTILES OF THE WORLD

By Raymond L. Ditmars, Litt. D.

THIS book has been standard for a number of years where the crocodiles, turtles, tortoises, lizards, and snakes are concerned. The illustrations, comprising 89 plates, are all at the end, thus enabling the text to be printed on matt finish paper. Reptilian nomenclature has suffered many changes in the past few years, requiring drastic revisions in this volume. The book is a very readable one from the point of view of those not familiar with natural history. The author's position as curator of mammals and reptiles at the New York Zoological Park has enabled him to study his guests with a closeness denied to others.—$5.25 postpaid.—*A. A. H,*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY
Member of the New York Bar

New Fruits Dedicated to the Public

FRUIT specialists at the New York State Experiment Station at Geneva have never taken advantage of the extension of the federal patent law to cover new creations in the plant kingdom because they have been desirous of having their new fruit varieties propagated and distributed as widely and as rapidly as possible, say Station officials in a recent statement. A considerable number of plant patents have been issued by the government during the three years that the new provision has been in effect, including several on roses and other flowers and a dozen or more on new fruits.

The appearance of the 1934 Catalog of New Fruits, prepared by the New York State Fruit Testing Association, which cooperates with the Experiment Station in the propagation and distribution of its new varieties, called forth the statement from the Station authorities on the question of patents. "The fruits in this catalog are not patented," they say, "and members of the New York Fruit Testing Association are asked to propagate and distribute them to the uttermost."

The Fruit Testing Association is described as a non-profit-making organization open to every fruit grower, either amateur or professional, who delights in trying out new fruits. The Association has members in every state and in many foreign countries. A nominal fee is charged for membership in return for which each member receives a premium in the form of one tree of some especially promising variety or 12 berry plants selected from the list of new small fruits. Members also have first choice of all stocks listed by the Association.

The catalog of the Association contains brief descriptions of 80-odd new fruits with information on the sorts best adapted to commercial planting and those kinds deemed best for the home garden. A copy of the catalog may be obtained free of charge upon request to the Experiment Station by anyone interested in fruit growing.

"Chipso" Trademark Cancelled

IN the case of J. L. Prescott Company v. The Procter and Gamble Company, First Assistant Commissioner Kinnan held that The Procter and Gamble Company of Cincinnati, Ohio, was not entitled to register, as a trademark for soap chips or flakes, the term "Chipso" and that the registration which it had obtained should be cancelled in view of the prior adoption and use by the J. L. Prescott Company, of Passaic, New Jersey, of the term "Chase-O" upon a detergent preparation in crystal form for washing and cleansing and the harmless bleaching of clothes.

In his decision, after stating that the record showed that petitioner through its predecessors had continuously used the mark "Chase-O" upon its goods several years prior to the earliest date of adoption and use claimed by the respondent, the First Assistant Commissioner said.

"Without setting forth here in detail the various ingredients of the petitioner's compound or the subsequently made change in it by the addition of a percentage of soap, it will be sufficient to state that the goods of both parties are held to possess the same descriptive properties and to belong to the same class as these terms in the trademark statutes have been construed in a number of decisions relied upon by the examiner of trademark interferences. In fact, the decision rendered upon the case involving these same parties, The Procter and Gamble Company v. J. L. Prescott Company, 413 O.G. 1105, 18 C.C.P.A. (Patents) 1433, holding the goods there involved as possessing the same descriptive properties, is regarded as determinative of this point in the case at bar."

Argentina Copyright Law

ARGENTINA'S "intellectual property bill" has been passed by the Chamber of Deputies and is now a law. The first copyright law in Argentina, it is designed to frustrate the pirating of books, plays, and music. Under its terms, a copyright runs for 30 years after the death of the author. It protects syndicated newspaper articles, but regarding news it declares that the reporting of current events is not a matter for copyright, but if news is pirated the laws governing unfair competition will prevail.

Packaged Coal

"PACKAGED coal" has made its appearance in Canada for the first time in the history of the industry. The coal is put in 100-pound bags at the mines. The size, weight, and shipper's name are imprinted on each bag, which is sealed. In other words, this coal is sold exactly the same as any trademarked packaged commodity.

"Flex-O-Back" Trademark Registrable

IT was recently held by First Assistant Commissioner Kinnan that the term "Flex-O-Back" is not merely descriptive as used upon ladies' corsets, corselets, girdles, et cetera, and that The La Resista Corset Company, of Bridgeport, Connecticut, is entitled to registration of that mark.

In his decision he noted that the opposition of the Luxite Silk Products Company, of Milwaukee, Wisconsin, was dismissed by the examiner of interferences and no appeal was taken and that appeal was taken by the applicant from the decision of the examiner of interferences holding its mark merely descriptive. The First Assistant Commissioner then said.

"While the word 'Flex' is well known and has a recognized meaning and while the various garments are flexible in various ways and places, and possibly some are more flexible in the back than in other portions, yet the mark when viewed in its entirety is deemed suggestive rather than merely descriptive of the goods or of their character or quality. It is thought the applicant should not be denied the registration for which it has applied."

Battery Rejuvenation

THE Federal Trade Commission recently issued a formal complaint against the Lightning Company, St. Paul, Minnesota, charging that the respondent is engaged in the sale of a purported electric battery rejuvenator known as "Lightning Electrolyte" and has represented that the preparation "charges battery instantly," "makes old batteries work like new," "doubles the life of a battery," and so on. Such claims, the Commission alleges, are false, misleading, and deceptive.

The Lightning Company in an answer filed by John E. Mickman denies that its advertising statements have been false, misleading, and deceptive. It states that it does not now use newspaper or magazine advertising, alleging that the Better Business Bureau prevents it from so doing.

Copper Back Mirrors

AN order has been issued by the Federal Trade Commission to Hires Turner Glass Company, Philadelphia, to cease using certain designations in the sale of a type of mirror which has a protective coating or backing consisting of a mixture of shellac and copper dust or powdered copper, which were described and advertised as "copper back mirrors," "copper backed mirrors," and as "mirrors backed with copper."

Another type of mirror made by companies other than Hires Turner, was found to have a protective backing of a continuous sheath or film of solid copper deposited on the silver reflecting medium by the electrolytic process. This type had been known for years as "copper back" and by similar designations. Such terminology had become known among a substantial part of the trade and purchasing public as applying to such mirrors, prior to the time the Hires Turner Company began to make and advertise its type of mirror having a backing of shellac and powdered copper as described above.

The company is ordered to cease using the terms "copper back," "copper backed," "backed with copper," or similar designations to describe its mirrors having a protective coating consisting of a mixture of shellac and powdered copper.

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NINETIETH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

Cover

A GIGANTIC shadow—like a hovering spirit of industrial progress—attends the manufacture of motor frames by arc welding. In a few short years this has become a major process for joining metals, largely through the outstanding development work of The Lincoln Electric Company, by courtesy of whom our cover picture is used.

SCIENTIFIC AMERICAN, February, 1934. Vol. No. 150, No. 2, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Copyrighted 1934 by Munn & Company, Inc. Great Britain rights reserved. Subscription price $4.00 per year. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

"STATIC electricity may be eventually harnessed for driving motors and this prospect is attractive on account of the enormous power output of such a machine at very high voltages. The efficient generation and control of these is the chief impediment in this direction." With these sentences Dr. Nikola Tesla closes a most interesting and informative discussion of the possibilities of electrostatic generators. This article, prompted by the nation-wide interest in Dr. Van de Graaff's high-voltage direct-current generator described on page 96 of this issue, was prepared especially for SCIENTIFIC AMERICAN by Dr. Tesla. It is, in our opinion, the clearest and most concise explanation of these electrical generators that has ever appeared in print. As Dr. Tesla says: "Knowledge of static electricity dates back to the earliest dawn of civilization but for ages it remained merely an interesting and mystifying phenomenon." We are all familiar with the small static machines of the high-school laboratory but most of us have thought of them as nothing more than interesting playthings. Now, apparently, they are growing up and hold a world of promise for the future.

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Newspapers throughout the country have aroused great interest in the subject of artificial impregnation performed by a physician, by their reports on a specific case of this type. Although the practice of artificial impregnation is not by any means widespread, it has certain highly interesting scientific, moral, and legal aspects. No social menace appears to be involved and so far as is known it is not illegal. John Harvey Caldwell has made an extensive survey of a number of doctors situated in widely separated cities and has obtained from them expressions of opinion regarding artificial impregnation. These opinions have been used as a basis of an article which will be published soon, and which discusses this subject in an informative, logical, and unprejudiced manner.

●

Air conditioning as an aid to industrial and business working conditions has obtained a firm foothold in this country. It is not, however, in very wide use as yet in the home. One reason for this, perhaps, is because research work has not progressed sufficiently to enable engineers to make efficient installations under the widely varying conditions found in homes. In an attempt to remedy this condition and to provide a working basis for future operations, a research laboratory for air conditioning in the home has been established. An article to be published soon tells of this laboratory, its equipment, and methods of operation. The knowledge which will be obtained as a result of the experimental work now going on, may have a very definite effect on both comfort and health.

It may seem to be a far cry from air conditioning equipment in the home to the construction of Boulder Dam in the Grand Canyon of the Colorado River. There is, however, a definite linkage. Refrigerating equipment has been installed on the Boulder Dam site for no other reason than to cool concrete. It has been known for some time that the chemical reactions which accompany the setting of Portland cement in concrete releases a considerable quantity of heat which in the case of some of the work at Boulder Dam may be expected to raise the temperature of the concrete mass on an average of about 40 degrees, Fahrenheit, above the temperature at which it is cast. In order to insure proper setting and curing of the concrete over an extended period of time it is desirable to reduce this temperature rise as much as possible. This is now being done by means of the refrigerating plant at the dam site. How the work is carried on and the results that are being obtained will be told in an article scheduled to appear in an early number.

●

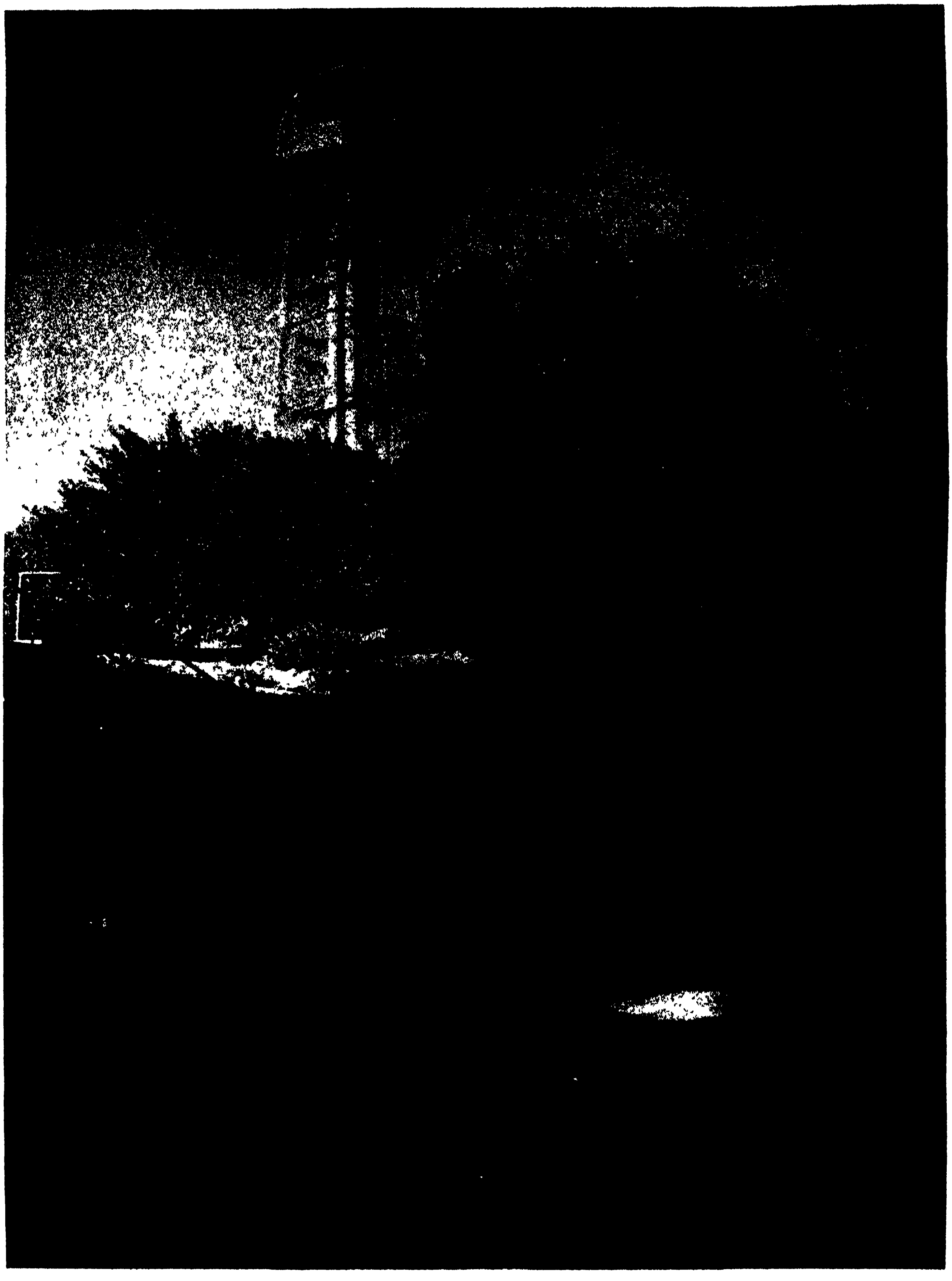
"There is not much energy concentrated in half a peanut, in a gram of cane sugar, in one and one half grams of white bread, or in four grams of the edible part of a banana, yet, little as there is, there is enough in each of these portions to supply the surplusage of energy that an hour of intense mental effort requires." Thus is introduced an article to appear in SCIENTIFIC AMERICAN in the near future, which tells some surprising things about the effects on the human body of the consumption of foods. The article, prepared by Carnegie Institution of Washington, and based upon a recent experimental investigation by Dr. Francis G. Benedict, Director of the Nutrition Laboratory of the Institution, brings the great work that physiologists are doing in their field of investigation once again to general attention. When you finish reading this article you will have obtained a broad and comprehensive idea of nutrition and its effect on working and thinking.

●

Most people, if they give the subject any thought at all, would probably be inclined to dismiss "blimps" as being "those funny looking little balloons that apparently have no practical use whatsoever." The many applications of these small airships are not generally known and for this reason we are pleased to announce that in our March issue we will present an article which will not only clear up many misconceptions about blimps but will tell of the multitude of uses to which they can be put both in times of peace and in war. This article was specially written for us by John T. Rowland, late Lieutenant U.S.N.R.F.

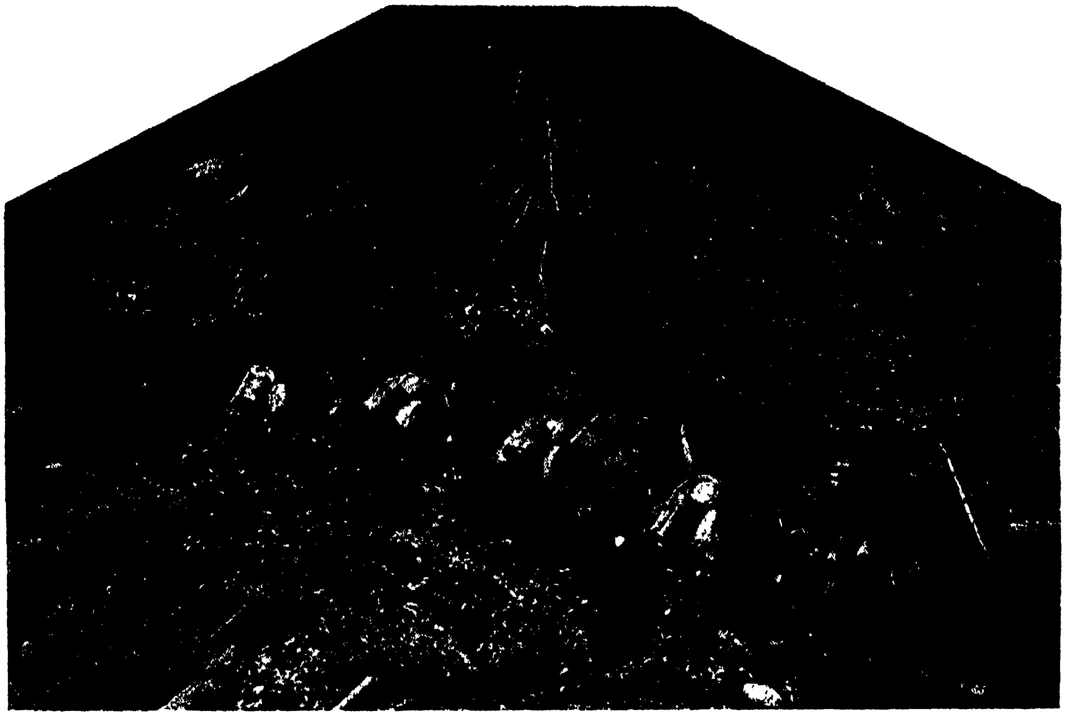
Orson D. Munn

Editor and Publisher



ATTRACTIVE MOUNT WILSON OBSERVATORY

THE 60-foot vertical or tower telescope at the Mount Wilson Observatory, amid its attractive surroundings. The trees are canyon oaks. An unusual photograph with excellent artistic composition, made by Mr. Malcolm K. Parkhurst of New York, from whom originals may be obtained for framing. The tower telescope is intended solely for use in connection with the sun. The solar rays are caught on a movable plane mirror at the top of the tower, are reflected to a fixed plane mirror nearby and pass through a 12-inch objective which focuses them on the slit of a spectrograph 60 feet below.



The "blister busters" often have to use toxic chemicals to destroy the germinating places of the highly active blister rust spores. Here a pack train is transporting 100-pound kegs of chemicals

Blister Busters

By CHARLES LATHROP PACK

President of the American Tree Association

THERE is an enemy advancing on the forests of the United States. Not only is it threatening the three million acres of white pine in the inland empire of western Montana, northern Idaho, and eastern Washington, but vast acreage elsewhere. Whether or not this invader is successful means much to the carpenter in Maine, the builder in Kentucky, and the furniture manufacturer in Grand Rapids.

This invader is a modernist in methods of warfare. He disdains the weapons of yesterday and uses those of tomorrow. He employs that most vicious and subtle tool of death--germ warfare. Opposing his advance has been a small and valiant detachment of shock troops fighting against great odds. These have now been greatly reinforced, but the battle continues to rage. The enemy goes by the name of Blister Rust; the shock troops are the Federal blister rust control workers; the reinforcements are the young and numerous recruits from the Civilian Conservation Corps who are getting their first baptism of fire in the eternal war of Nature.

This is not a new conflict. Yet, despite stubborn defense by the professional soldiers in the field, the spring of 1933 found a discouraging condition. By the effective stratagem of infiltration the enemy was rapidly occupying new areas. Faced with this situation, the intelligence service of the conservation forces reported that nothing short of a major offensive would be effective. The standing force of trained troops was pitifully small, they declared, and their service of supply woefully inadequate. It was, indeed, a Marne in the conservation war. But reinforcements were forthcoming. New troops were rushed to the front and the battle is now going forward with good reason to hope for ultimate victory.

LEST we become too involved, perhaps we had best drop the military metaphor. At the same time, however, we re-emphasize the fact that the threat of the white pine blister rust concerns every American who uses wood, whether it be matches or matched timbers. Yet, unknown to the majority, the Division of Blister Rust Control of the United States Department of Agriculture has beeh fighting their battle. (There we go, getting military again!) The work has been done by insufficient numbers backed by inadequate funds. Much has been accomplished in the face of these handicaps. Now, men are available from the Civilian Conservation Corps and more money is set aside from the public works fund.

A word about the C. C. C. Many people have had and, perhaps, still have the idea that these three hundred thousand young men were enrolled, divided up into groups, and told to go out and plant trees. Conservation, however, is a large word. It means more than just putting loafing acres to work growing trees, important as that may be. It means the protection of existing trees from fire and disease. It means the cutting of fire lines and the building of roads and trails so that forest fire destruction may be reduced. It means the development of areas, such as National Forests and National Parks, that have been conserved for the use of all of the people. It even includes the improvement of certain large areas set aside as refuges for migratory birds. And, certainly, the preservation of immensely valuable and important forests of white pine comes under the head of conservation.

So, joined in the offensive against the enemy of the white pine are members of 208 of the conservation camps located in 22 states. By mid-August more than twelve thousand of the boys were battling. At that time their drive had accounted for more than twelve million currant and gooseberry bushes, which the scientists

Happy C. C. C. boys with a pile of pulled-up Ribes, representing 300 feet of live stem

call "Ribes," and they had turned 150,-000 acres of pine lands into No-Ribes Land. Although charged merely with the task of organization, the Army men in charge of the camps have come to regard this work in the light of national defense. They have extended the most whole-hearted co-operation and this has been reflected in the spirit of the men working in the woods.

Commercial white pine forests at present occupy approximately twenty million acres in the United States, about half in the east and half in the west. The Federal Government owns one third of the total stand of seventy billion board feet of white pine saw timber, and the total value of all timber of this species is estimated at 420,000,000 dollars. An immense economic stake is involved. A definite campaign has been mapped out and the Conservation Corps boys have swung into line.

HERE is the way in which one of the boys, whose name, incidentally, is Forrest, writes home to the folks about what he is doing:

"Down in the jungle of swamp-willow and alder brush grow the gooseberry and currant, technically known as Ribes. Some are big and some are small. Almost all of them are full of thorns.

"From foreign shores has come the disease known as blister rust. It kills the white pines, which are rather valuable. The spores, or germs, develop on the Ribes and go from there to the pine. Which, as you see, completes its life cycle. So, if the Ribes are destroyed, the pine is saved.

"This germ can travel a distance of 900 feet and still do its work. Therefore the Ribes must be done away with within an area of 900 feet of the white pine stand.

"In the spring five of us were picked out, or picked on, by the technical man in charge and shown how it goes. This is it:

"The men line up, about five or six feet apart. Number one has a line to follow through the woods. A string or line of papers hung on the bushes extends from end to end of the area to be worked. The man on the opposite end of the line-up lays another line as he goes along, thus making it possible to cover every inch of the ground.

"When the mosquitos, May flies, June bugs, deer flies, and what-nots are busy, in a temperature of about a hundred, more or less, and swamp water is up to your knees, life is not always a bowl of cherries. Perhaps the sight of 20 more or less grown men following a string through the woods is laughable. At times I get the laugh on the laughers, however. I have been chosen foreman of the crew. If we lose a man through K. P. duty or illness or plain laziness, then one of the humorous ones is chosen and becomes a Blister Buster himself."

Which, after all, is a rather good though sketchy picture of what is being done by about seven thousand members of the C. C. C., boys from the sidewalks of the cities who are gaining health and experience in the outdoors. The manner in which the blister rust goes about its destructive activity merits, however, a somewhat more complete description than Forrest gives it.

THE interesting thing about this disease, and the key to its control, lies in the fact that it must use an intermediary or secondary host to complete its life cycle. The rust is a fungus. It appears first in the spring as a blister-like white sac on the bark of the white pine. These sacs burst open and give to the wind millions of tiny, seed-like bodies known as spores. They can travel long distances with the aid of a stiff breeze. When, in their voyaging, they light on the leaves of certain species of currant and gooseberry—lumped together as Ribes in control terminology—they are happy little spores. They stay right there and set about to germinate, infecting the leaves and, by early summer, forming orange-colored pustules on the under-leaf surfaces.

The rust knows no summer holiday, but spends that season spreading locally over leaf after leaf and bush after bush. It uses a different kind of spore for this ubiquitous activity. When fall comes along hair-like bodies appear on the rusted leaves. These bear spores and the wind again helps to carry these back to the pines. They make relatively short trips at this time but they get amazing results. They infect the pines only through the needles. From these fingertips of the tree the fungus sends its tiny microscopic threads back through the needle into the twig and thence to the branch or the bole of the tree. First evidence that the tree is stricken is an orange discloration on branch and bole. Then, in a year or so, the blisters form, let loose their spores and the life cycle goes on. The pine is doomed.

Within the bark a canker develops. This grows both vertically and horizontally. If it continues its horizontal path around the pine it is just as fatal as though its host had been girdled with an axe. Usually the canker takes the top of the tree, causing starvation of the rest or death through the attacks of secondary fungi. A more recent mode of rust killing has been found in the west. In these cases, the full significance of which is not yet known, the rust has not reached the trunk but has infected so many twigs as to remove all foliage and rapidly kill the tree.

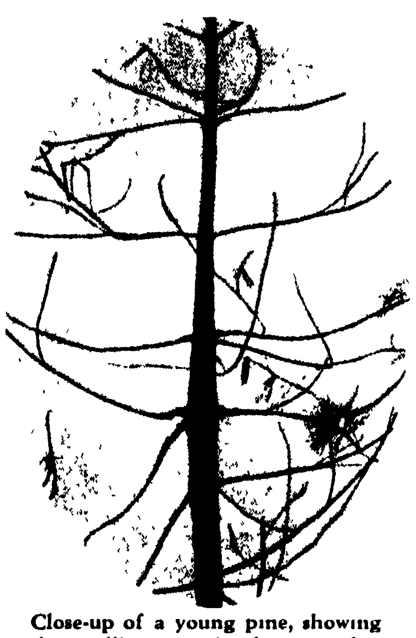
A young white pine that has been killed by insidious blister rust

Since only Ribes bushes can nurture and spread the fungus, the method of control is obvious. It's out damned Ribes and spare none. These pestiferous Ribes, of which there are 62 different kinds growing wild in the woods, effect various methods and locales of growth and have to be attacked in different ways. A whole battle plan has been worked out based on exhaustive research and study of their habits. The sticky currant, for example, likes wooded slopes back from streams and has a way of springing up in burned over areas. The white-stemmed gooseberry and the wild black currant inhabit moist and swampy spots. The prickly currant is abundant in stream

bottoms, although often found also on wooded slopes.

Control of the blister rust is not a year-around job. It must be done during the few months of the year when currant and gooseberry bushes are in leaf. Frost or severe drought causes the leaves to fall in mid-season and retards the work. Eradication also calls for work of high quality, thus demanding specialized and highly-trained supervision to a degree greater than almost any other forest management operation for which common labor is employed.

Study has shown that the white-stemmed gooseberry and the wild black currant are Public Enemies One and Two in the western white pine region. They are the most eager hosts to the spores. Since they grow in profusion along stream banks they are called "stream type Ribes," and assault upon them comes first on the control list. They concentrate so thickly, however, often partly under water, that pulling them up by hand was found next to impossible. A solution of water and sodium chlorate and, later, the less hazardous calcium chlorate—was tried on the wild black currant. It died under



Close-up of a young pine, showing the girdling growth of rust canker

this treatment, and wild black currants have been getting generous baths of it ever since. The white-stemmed gooseberry proved to be less easily killed by this chemical but its destruction is being effectively accomplished by improved chemical sprays supplemented by hand pulling where necessary. In California sugar pine forests these bushes have been effectively cleared out where most numerous by spraying Diesel engine oil on them.

Once an area has been surveyed and the chemical needs estimated, areas are laid off as described earlier by our friend Forrest. Usually spraying equipment carried on the back like a knapsack is used. In places where it is practicable, "bulldozers"—trail-building tractors with toothed instead of solid blades are sent snorting about tearing up the offending bushes by the roots and piling them up to dry. These are later burned and the region sowed to grass. The Ribes seedlings have a hard time establishing themselves in sod. Thus, worthless brush land is converted into valuable pasturage and the Ribes are no more. Experimental work to increase effectiveness of control work and to cut its costs is continually being conducted along with the task of eradication.

Studies of the upland species of Ribes found them somewhat temperamental. They react to different conditions of light and moisture, and are exacting as to conditions under which the seeds germinate and the seedlings survive. The seeds have a faculty of lying dormant in the duff of the forest until conditions suit them and then appearing in great numbers. With such knowledge, control of their activities has been materially aided and workers know what to look for.

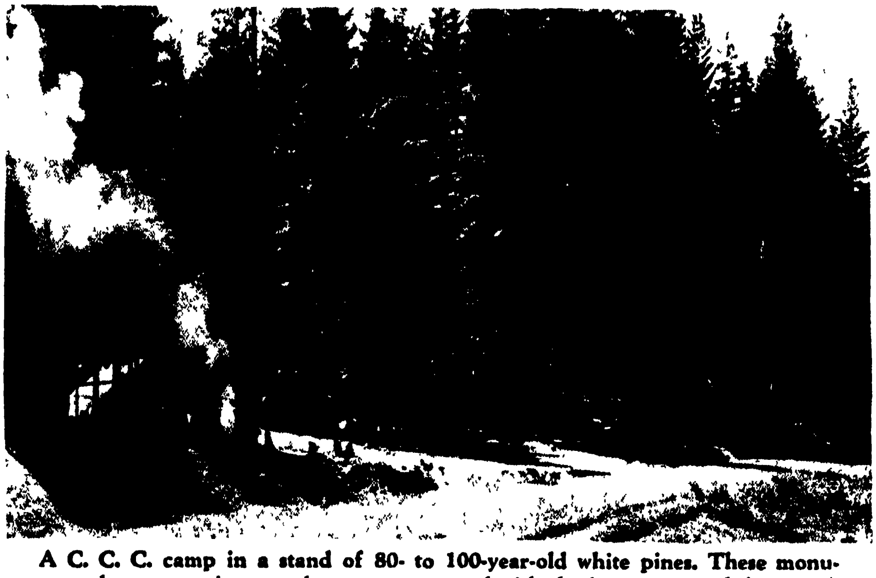
An immigrant from Europe, the white pine disease first made its appearance in eastern white pine forests about 30 years ago. Its devastation has been considerable, but the wide extent over which control has already been applied in the east assures continuation of these forests.

THE blister rust was introduced into western North America in 1910 on a shipment of small pines from France. Since then it has spread east and southeast from Vancouver, B. C., to the southern end of the Idaho white pine belt, 400 miles away, and to Port Orford, Oregon, 450 miles south.

The emergency due to the rust is greatest in Idaho where white pine lumber forms a large part of the economic foundation of the region. Western white pine, also, has been found highly susceptible to the rust, and the largest trees will be killed rapidly in areas which are not protected by 1936. Worse, the magnificent sugar pine of California is even more susceptible to blister rust attacks than is the western white pine. However, the rust is not yet known to be in California, where millions of acres of sugar pines would be affected. As a preventive measure, five hundred Conservation Corps men are eradicating Ribes at strategic California points before it is too late. The notable sugar pine forests of Yosemite National Park are included in the California protection program.

In drawing upon the C. C. C. for the much-needed reinforcements, it was first necessary to train leaders. Men were chosen at various camps and put through a course of intensive training. They learned how to track the festive Ribes to its lair and to know what it looked like in its various forms. They practiced methods of crew organization and took an elementary course in the technical phases of the job. They were then equipped to serve as superintendents, foremen, or checkers under the technically-trained men from the Division of Blister Rust Control and the Forest Service.

BY last fall, protective work had been completed on more than 100,000 acres in the west alone. Results of past work conducted on a smaller scale by the workers of the Blister Rust Control Division provide a rule by which the immense value of this additional manpower may be measured. With additional funds now available from the public works fund, and with the prospect of continued C. C. C. help, the Division of Blister Rust Control is looking hopefully into the future.



A C. C. C. camp in a stand of 80- to 100-year-old white pines. These monumental trees ever impress the camp personnel with the importance of their work

The Second SCIENTIFIC AMERICAN

TEST FOR TELEPATHY

Brought Forth Little Data Which Could Not Be Ascribed to the Operation of Chance

THE rules for conduct of SCIENTIFIC AMERICAN'S second test for telepathy were published in our June, 1933, issue. The collected results received from our readers have been carefully studied and a complete report made by Dr. Walter Franklin Prince. Since no startling evidences for telepathy were revealed, we record here only some of the difficulties of the test and a few of the results obtained.

It is self evident that any conclusive series of tests for telepathy must be conducted in rigid conformity to a carefully prepared set of rules. In answer to the question of how far the experimenters followed the directions laid down, Dr. Prince notes the following: One couple did not send in the percipient's papers, but the agent copied them in his own handwriting. In another case, where several groups of test sheets were sent in, some of the original papers of the percipient were returned, but the greater part of the records omit all the original sheets and were simply copied in typewriting.

So much for such deviations from the necessary mechanical requirements of the test; those noted are typical of many others that were made. More important was the direction that the agent should select "the name of some simple and familiar object which he can readily visualize." Many of the agents observed this rule, but others selected such words as "pain," "music," "free love," "wind," and so on. It is obvious that, in a test of this kind, results cannot be expected if the agent cannot vividly visualize the object to be "transmitted."

We now come to the actual analyses of the various lists of words. Space will not permit a full report, and we will therefore omit those which may be listed as total failures. As in our first telepathy test (for results of this see July, 1933, issue) we received a perfect (?) result from the man who claims: "I was born with telepathy . . . these things are easy for me and I know that there is no one else in the world who can do it." From the nature of the report, it can be dismissed as being the work of a paranoiac or, at least, a hopeless crank.

ONE group of 30 experiments—10 between the correspondent and his wife, 10 between the wife and, presumably, her son, and 10 between the correspondent and another lady appear, upon first examination, to hold some promise. But ruthless analysis must be applied. In spite of directions to the contrary, 17 and possibly 21 of the 30 objects named by the agent were probably either visible or audible at the time of the test. The word "tree," third in each list, may have been suggested to the agent by glancing out of the window and to the percipient by following the glance. "Automobile" is number 8 on agent's list and 7 on the percipient's; the latter may have first glanced at a car through the window, unconsciously suggesting to the agent the selection of that word for his next number. In concluding his analysis of this group of tests, Dr. Prince says: "There may be some grain of telepathy in this series but it furnishes not a grain of proof."

In another set, the agent attempted his own analysis and called attention to the fact that similar words appeared in the agent's list for one test and in the percipient's for a later one. This can hardly be held to be evidence, as we cannot go back of the record. If we could, we would allow chance to play such a part as to vitiate all results.

THE following comment is quoted from Dr. Prince's analysis of another set of 50 experiments: "Agent's number 7 and percipient's 8 are, respectively, 'bicycle' and 'motorcycle.' We are accustomed to look with leniency upon a correspondence which occurs on the part of the percipient one number after the agent's. Even a correspondence two numbers later might be deferred telepathy, although the weight of such an instance is comparatively small. A's 34 ('steamboat rainbow') is a little ambiguous but probably he had in mind a steamboat named *Rainbow*. P's 34 was 'sailboat.' A's 40 is 'pistol' and P's 40 'cannon,' which makes one think a bit.

"The correspondences 'bicycle' and 'motorcycle,' 'steamboat' and 'sailboat,' 'pistol' and 'cannon' are statistically, as proved by experiments in guessing, really much beyond expectation. There is not enough in this series to demonstrate telepathy—nothing like what the Sinclairs would get in a series of only 10 to 14 objects—yet the results are sufficient to make it worth while for these subjects, exercising every possible care as to conditions, to experiment further."

There are other tests in our files which show rather far-fetched apparent coincidences, but the above suffice as representative of them all. When the bright light of impartial analysis is applied, and every conceivable loophole is closed to the operation of something other than telepathy, they all reduce to the same level, and the final verdict to be given in our tests must read "Not Proved."

WITH this issue *Scientific American* brings to a close its active participation in research for telepathy. When we started our telepathy tests early in 1933, we consulted several of the best minds in psychology regarding the then proposed procedure. There was a general agreement that any series of tests which would add to the data regarding telepathy would be of value for further study. Since, in scientific research, any avenue which offers a possibility of results is worth following, we have devoted considerable time and space to the subject of telepathy. The report of our first test (July, 1933) showed a slight tendency toward the operation of something other than chance; results of our second test appear on this page. It now appears that further tests, to be of the greatest value, must be conducted under controlled laboratory conditions.

We wish to thank those of our readers who have been good enough to take part in our tests, and also those who have offered suggestions for further investigations. Those who have written to us regarding apparent telepathic experiences have also done a great service to science, and their recorded statements will be of great value to psychology. These records will be kept in absolute confidence, and no names will be divulged in print without permission.

—The Editor.

OUR POINT OF VIEW

The Mail Goes Through

DURING a recent spell of bad weather, two airmail planes crashed in the wildest part of the Allegheny Mountains in Pennsylvania. All scheduled passenger air-transports had been grounded by flying conditions but, true to the traditions of the service, the mail went through. Both pilots of the doomed planes were in constant radio communication with Newark Airport up to the minute when they decided that the coating of ice and snow gathering on the wings would make further progress impossible. "I'm falling 500 feet a minute," radioed one of the pilots. "Guess I'll go over the side. So long."

Parachutes saved the lives of the airmen, Harold Gay Andrews and Dean Burford, both veterans of the service, but their planes crashed in the snow-covered mountains. Through the storm they struggled to their planes, extricated the registered mail pouches, and made their respective ways to the nearest villages.

Thus, briefly, is written a short chapter of the history of aviation and the airmail. A useless waste of planes? A risk of human lives that was unwarranted? We think not. The tradition of the mail is one on which rests a large part of the economic structure of this country. It must be preserved at almost any cost. The fact that these two pilots came through with their lives and that they reclaimed the mail points to several things. First, they knew their ships and their business and were equipped with efficient parachutes. Secondly, they were in constant communication with the airport so that in case of trouble, rescue parties could be dispatched immediately. Thirdly, there was no fire to destroy the mails, due to the presence of mind of the pilots in shutting off the ignition before bailing out.

The airmail in the United States has a record of which we may well be proud. It cannot fail to grow when the ships are in the hands of such pilots as Andrews and Burford.

Streamlined Motor Cars

WRITING of motor car design in general, and streamlining in particular, a correspondent to the *New York Herald Tribune* makes the following remark: "Streamlining, of course, in automobile design is the bunk. No motor should be driven fast enough to have wind resistance make any appreciable difference." Since this appears to be a more or less general impression, we hasten to correct it. The essential reason for streamline design is not to obtain more speed, but to achieve practical speeds with a minimum of horsepower and hence a minimum of gasoline consumption. Above 30 miles per hour, wind resistence is an increasingly important factor in power consumption. Since the average motor car speed today, as pointed out in the article starting on page 76 of this issue, is in excess of 40 miles per hour, it will be seen that streamlining can and will have a direct and important effect on the motorist's pocketbook.

We hope that automobile manufacturers will take to heart the teachings of the science of aerodynamics, and that soon there will be available cars in which the gasoline we have to pay for will be used to get us over the ground at a reasonable speed without sacrificing a large proportion of the power developed to overcoming wind resistence.

Absent-Minded Professors

POPULARLY a scientist is supposed to be a tall, gaunt figure clad in a long white smock. He wears whiskers, a pair of Oxford glasses on a black ribbon, and he spends his life gazing at the contents of a test tube. His surroundings seem to consist of a microscope—if more surroundings are needed, two microscopes.

Go to any gathering of scientific men, whether physicists or chemists, biologists or anthropologists, and take a census of whiskers, Oxford glasses, and other scenic effects. Today not two men of science in a hundred sport the traditional hirsute adornment, while the scientific man who dared appear in the stilted Oxford glasses and ribbon of the traditional concept would be an object of amusement among his colleagues.

Your man of science is today a plain unaffected fellow, dressed about as you are. He speaks about as you do and he is as human as you are. He enjoys a good time as well as you do and he isn't above raising Cain a little now and then for the good of his soul. In short, he is just a plain average man.

Gone, too, is the typical absent-minded professor of the comic cartoon —at least professors are not more absent in mind than most of us, and aren't we all absent-minded at times? One of the most absent-minded men was Painlevé, a noted mathematician. It is said that he would take a taxi home when his own car was waiting for him. When the taxi driver asked for his address he often gave his telephone number. Once, expecting a friend, he pinned a note on his own door: "Painlevé will return in 15 minutes." On returning he saw his own note and sat down on the step and waited for himself. But Painlevé was also a politician—thrice premier of France. Perhaps he was absent-minded as a mathematician and present-minded as a politician—if not the reverse.

Scientists, after all, are "just folks." It is time the traditional concept of them should be chloroformed.

A Magnificent Flight

KINGS and queens, prime ministers, and presidents have rendered homage once more to aviation's "Royal Family," Colonel and Mrs. Lindbergh, on their remarkable air jaunt across the North Atlantic; back and forth across Europe, the British Isles, and Africa; and across the South Atlantic to Brazil. As this is being written they have landed in Florida on their way from South America for Christmas at home.

In flying as they have, to all outward appearances casually and as whim led them—like carefree adventurers—they have shown again, in true Lindbergh fashion, that the airplane, in competent hands, is as safe as the automobile. Leaving the United States July 9, they explored the North Atlantic as it never before has been explored. Extraordinarily dangerous flights, such as crossing the Greenland ice cap twice, were taken as all in the day's work; and the crossing of the South Atlantic with hardly more fanfare than obtained when the Colonel took off from New York for Paris one spring day in 1927.

The record of this flight is perhaps the greatest testimonial to aviation ever written—to American aviation. We extend to the Colonel and his expert assistant, Anne, our sincere congratulations. We have, however, one friendly suggestion to make:

Colonel Lindbergh is the symbol of American aviation; he is the personification of its progress and its triumphs. We hope, therefore, that on completion of the present trip, he will be content to leave more of the future pioneering to others, will himself live less dangerously, at the same time giving of his wide knowledge to the furtherance of aviation.

A Doctor Looks at Smoke and Dust

By W. W. McFARLAND, M.D.
Director of the Department of Public Health, City of Pittsburgh, Pennsylvania

THIRTY years ago an Allegheny County judge, sitting in Pittsburgh and ruling on the application of a litigant for relief from ore dust, declared that if the people could not stand the consequences incident to a manufacturing district they could move out of town. He very probably was sincere in believing at that time that nothing could be done in the way of curbing air pollution.

It is a matter of record, however, that eight years later Mellon Institute of Industrial Research was launched upon the nation's first comprehensive survey of municipal atmospheric contamination, and that, on the basis of facts uncovered in its 1911 to 1913 surveys, something did begin to happen about smoke and dust in Pittsburgh, and things have been happening ever since.

People did not have to move to get relief. Under the program of gradual improvement adopted by the city, the air of Pittsburgh slowly but steadily has progressed toward a condition of hygienic purity. That program will continue to be pressed until the city's atmosphere has been restored to as near its pristine state as is practically attainable. It has yet a considerable distance to go, but it is on its way and will not be turned aside.

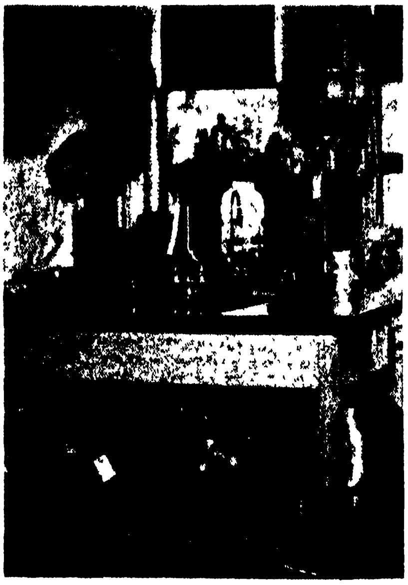
This brief historical statement is given as a means of assisting an intelligent understanding of Mellon Institute's latest contribution in the struggle which all cities must continue to carry on against the pollution of their air supply.

Under the supervision of H. B. Meller, the head of its Air Pollution Investigation, Mellon Institute has prepared a practical "Modern Plan for Community Campaign Against Air Pollution." Initial suggestion that such a plan be drawn up came from the College of Physicians in Philadelphia. A program of action is being developed there by a special committee appointed by the College. A lengthy abstract of the plan, as published in the *American Journal of the Medical Sciences*, is being widely studied and favorably commented on by physicians. Meantime, the New York Academy of Medicine's committee on Public Health Relations has scheduled a session where the plan will be discussed by its author, with special reference to application in the New York area.

MELLON INSTITUTE'S election to present its pure air campaign plans to medical societies is consistent with its handling of the problem from the very start of its investigation. It is a matter of record that campaigns against smoke and dust get satisfactory results only in cities where physicians take a leading hand. There is also the oft-repeated Institute declaration that since pure air is primarily a medical consideration, the necessity for medical leadership cannot safely be disregarded.

Along with the promulgation of the modern campaign plan, the Institute has expressed the opinion that an unusual opportunity exists to make progress in the restoration of hygienically pure air to the cities, and it urges medical societies to assert their leadership. It is pointed out that the scientific research workers, engineers, and others who would be entrusted with the execution of a municipal program want to know what substances, now present in city air, must come out to make that air conform to the necessities of human comfort and health. They wish to have the physicians set the limit for smokelessness and dustlessness.

For the benefit of the layman who might be constrained to think the physicians have been unduly hesitant or dilatory in asserting their leadership in this important matter, it should be explained that only recently have leading combustion engineers and other related specialists fully demonstrated their ability to fill a prescription for the smokeless and dustless operation of small as well as large fuel-burning plants, to be done practically and at reasonable cost. In these demonstrations, of course, they are employing appliances, processed fuels, and firing methods brought to perfection in the last few years. Under these altered circumstances, it can now be said with assurance that, if the physicians will write a prescription setting up reasonable standards of dustlessness and smokelessness, the engineers can fill it without committing fuel consumers to costly, experimental ventures. Always heretofore there has been the objection from some quarters that while pure air



Air hygiene studies are carried on in laboratories on a comprehensive scale

A steel plant in operation. The principal fuel is bituminous coal that is being properly used in the furnaces

is a city asset of fundamental value, its attainment could not be secured save at undue expense. Thanks to the efforts of inventors, research workers, manufacturers, and progressive fuel producers, that objection no longer holds good. Eighty percent of the solid particles now emitted by stacks where solid fuel or refuse is burned can be kept out of the air by tested appliances and processes that are not burdensomely expensive. In many cases, a large percentage of the cost would be returned as direct savings.

IN this connection, the engineers point out other interesting facts. The percentage of inefficient heating and power plants has increased greatly, due to slow rate of replacement during the depression period and to the fact that advantage to the full extent has not been taken of improvements in equipment and fuels developed by science. Given favorable credit conditions and expanding volume of business, heat and power makers may wish to move quickly to the purchase and installation of modern, economical equipment and harmonious fuels. A development of this sort should be anticipated. Where standards of smokelessness and dustlessness are to be set up by municipalities, early action to that effect is desirable. This would give fuel users advance notice and let them take advantage of the fact that the installation of equipment designed to control smoke and dust costs least when put in as a part of a general alteration or replacement job.

These are some of the considerations underlying the assertion that physicians, public health workers, and others interested in restoring pure air to cities are confronted with the opportunity of a generation for scoring substantial gains.

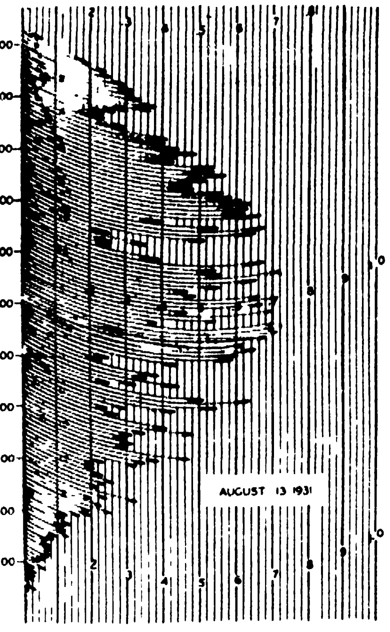
As a physician and health department executive, my primary concern with air pollution has to do with its medical aspects. There can hardly be any disagreement with Meller's statement as given in the preface to his plan: "Pure air is primarily a medical consideration and its maintenance is a municipal health department responsibility, just as are pure food and pure water."

IT has been reported that certain derivatives of tar will, through repeated irritation, cause cancer of the skin. These derivatives are among the constituents of soft coal and oil smoke, and may also enter the air from other industrial sources. Dr. Jerome Meyers, of the New York Department of Health, made a very interesting partial survey in this field a few years ago, in which he called attention to the apparent parallelism of high smoke content of the air and incidence of cancer. This study should be resumed in the light of most recent information and the improvement in the gathering and compiling of cancer statistics in New York City.

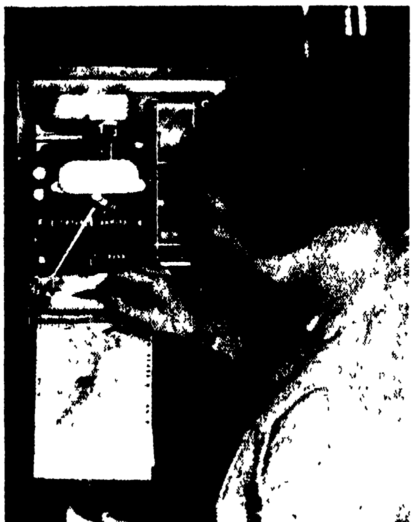
Other reported experiences and investigations include other harm done to health by dust, gases, or unburned (atomized) oil coming from stacks, and various metallic oxides and chemical substances thrown off by domestic and commercial incinerators and industrial plants.

Space does not permit a detailed account of the physiological effects of the various contaminants usually found in city air. A general observation will suffice: It is easier for the average man to keep up his bodily resistance to disease and to maintain vigor when he is making direct contact with strong sunshine and is breathing air of little dust content. Under such conditions the health hazards are fewest. Actually, man can exist wholly without sunlight and can endure considerable concentrations of some kinds of dusts. But the broad interests of medical science do not lie in the direction of encouraging such difficulties or of increasing the complications and artificialities of city life. Since it is easier, cheaper, and safer to live in intimate contact with unfiltered sunshine and air free of harmful pollutants, preventive medicine is properly concerned with a movement toward restoration of natural conditions. Preventable smoke and dust clouds that obstruct solar radiation and fill the nose, throat and lungs with irritants are perilous.

Over and beyond the physiological effects of atmospheric contamination are psychological aspects to which investigators have called attention. There is also an economic angle. All these are touched on in Mellon Institute's plan and will be studied by inventors, chemists, physicists, and others who must have a hand in filling any pure air prescription the physicians write.



Graph showing effect of clouds and smoke in blocking ultra-violet


Air pollution is found by recording ultra-violet rays received from sun


Smokeless firing of locomotives. Engines in the Pennsylvania yards in Pittsburgh ready for rail service

The Revised Food and Drugs Bill—What It Means to You

By T. SWANN HARDING

IN the days of the Restoration there lived in London a "Gentlewoman." She abode at "the Surgeon's Sign, just at the corner of Coventry-Court in the Haymarket, near Pickadilly," and she issued a Bill (or advertisement) in which she first praised God for making woman beautiful, and then offered to all and sundry "a highly approved 'Balsamick Essence,' with several other Incomparable Cosmeticks, *faithfully prepared without Mercury*" (*n.b.*) to keep her so in case she backslid from pulchritude. This Essence would remove all freckles, wrinkles, tan, sunburn, yellowness, and "morphew" in 30 days, and render "the skin plump, soft, fair, bright, smooth and of a lovely colour."

That just about covers the possibilities of a complete cosmetic and it is interesting to observe that they had not one, but many, way back there when Pepys kept his sly diary and Cromwell had not long been in his grave. It is even more interesting to know that at least one "Gentlewoman" cosmetician was so scrupulous about her wares that she scorned the use of the violent poison, mercury, in their preparation. It is therefore somewhat humiliating to reflect that within the past five years (and even today) American ladies have used and been poisoned by cosmetic preparations containing not only mercury, but lead, arsenic, thallium acetate (the rodent exterminator), and toxic organic compounds with astonishing names that would only confuse us if mentioned here.

IN the London of Restoration times it was known that mercury was a dangerous substance to put in cosmetics. Today the market of America is replete with hair tonics, ointments, freckle removers, beauty lotions, whitening creams, and other beautifiers containing this metal. The prolonged use of such cosmetics may cause severe skin irritation or even systematic poisoning, because the skin so readily absorbs mercury. The kidneys may be damaged irreparably, the teeth ulcerated, and the jaw bones may decay. Even death can ultimately result, for many individuals are highly susceptible to mercury poisoning. Arsenic occurs in many hair tonics and dandruff remedies. Lead appears in hair dyes and tonics and in scalp lotions. Thallium acetate was the active ingredient of a cream advertised to remove excess hair harmlessly, but which sent numerous ladies to hospitals, they having lost every hair on their bodies and been desperately ill besides. A dye to lend lure to eyelashes has produced many cases of severe dermatosis and, in several instances, has permanently impaired the vision of the users.

It is natural to ask: "How can such things be? Don't we have a Food and Drugs Law? Why don't the rascals down in Washington enforce it, protect the ladies from these poisonous cosmetics, render their kissproof lipsticks actually kissproof, and keep women, as one Middle Age quack described them, 'The Admirablest Creatures that ever God created under the Canopy of Heaven?' If mercurial cosmetic preparations were known to be dangerous in the 16th or 17th Century, what possible excuse can there be for their sale in America in the 20th Century? What is the matter with those impotent dodoes who make out they are enforcing the law?"

Testing digitalis in U. S. Food and Drug Administration Laboratory

At this point it is well to read the present Food and Drugs Act. That act defines a drug as an agent used in the treatment of disease. Freckles, excess hair, wrinkles, enlarged pores, falling hair, obesity, and dandruff are not diseases; they may be blemishes or botherations, but they no more classify as diseases than do irregularly architectured noses and shortness of stature. Hence cosmetics are not drugs, unless they make some specific claim to cure disease on their labels—which, generally speaking, they never do. Cosmetics are surely not foods. Gadgets to straighten noses are not drugs, and neither are mechanical chiropractors intended to stretch the short men to great height so that they may avoid the failures and humiliations those of small stature (like Napoleon) undergo.

THEREFORE the present Food and Drugs Act does not cover cosmetics. It does not cover therapeutic gadgets and contraptions, some of them selling for 10 dollars and costing 75 cents to make, and all of them as astonishingly magical in their claimed powers as the miraculous necklace some firm got out to cure goiter. The present law does not cover advertising, other than statements which appear on the labels of food and drug products or those made in booklets or folders that form an integral part of the package as sold. For that reason a common remedy advertised widely as good for all ills to which womanly flesh is heir, and really an innocuous mixture of useless herb extracts, bears on its label the mere statement that it is "Recommended as a vegetable tonic in conditions for which this preparation is adapted," meaning nothing at all and being true to fact!

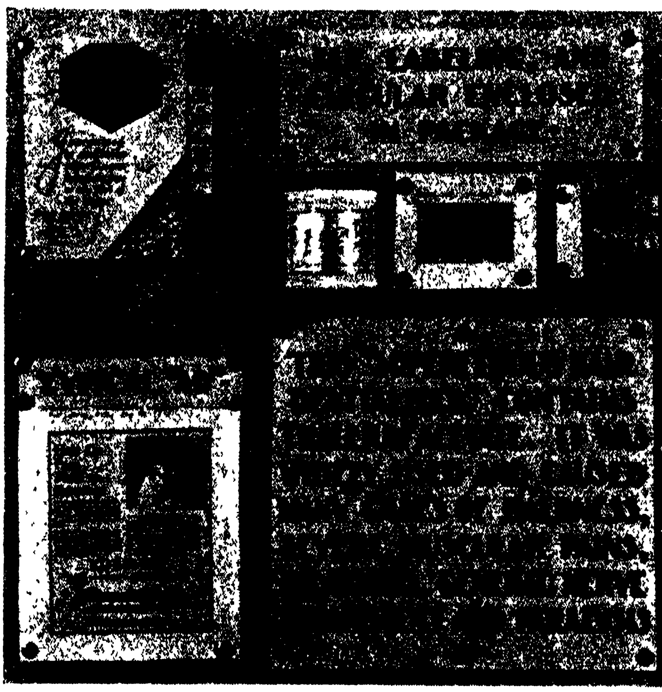
In consequence of these deficiencies which have made Dr. Harvey W. Wiley's Food and Drugs Act obsolete, a revision of that act has been prepared to supersede the old statute. It was written by legal and scientific experts in the Department of Agriculture, gained the blessing of the Administration, and was introduced in the Senate by Senator Copeland in June 1933 as S. 1944. That bill does specifically cover cosmetics. It covers gadgets and contrivances. It covers advertising, applying the same standard of accuracy to it that the present law applies to food and drug labels. It sets up food standards and it establishes minimum tolerances for the poison content of foods.

What will be the status of a cosmetic under that bill? Just two or three years ago a remedy for superfluous hair, in

the form of a cream, was advertised to ladies. They were to apply it freely, as they would a cold cream. It was said not only to be harmless but to be beneficial to the skin. Yet it contained 7 percent of the deadly poison thallium acetate, whereas the leading dermatologists in the world used never more than a 1 percent thallium acetate cream in their work, and this was applied with the utmost caution. Many skin experts would not prescribe the use of such creams at all. The revised Food and Drugs Bill will declare that a cosmetic (also a household remedy or proprietary medicine) must be harmless to the consumer when used as directed on the label. Secondly, it will say that no false or misleading statements can be made about any cosmetic, food, or drug product in magazine, newspaper, bill board, handbill, radio, or other advertising.

After all, no one knows better than the scrupulous manufacturer of cosmetics that unwarranted claims have injured this business severely. For that reason the cosmetic industry, except for its underworld elements, is behind the bill. Cosmetics cannot feed the skin, reduce flesh, eliminate wrinkles, remove enlarged pores, or perform magic. The true foundation of beauty is health, which depends largely on proper food, sleep, and exercise. Cosmetics have a legitimate function in enhancing natural beauty, but they do not need to contain poisons in order to perform that function. Claims for special merit due to incorporating turtle oil, strawberry juice, hormones, vitamins, buttermilk, milkweed, cucumber extract, lemon or other rare, precious, difficultly obtained, or mystical ingredients are not justifiable, while wrinkle and muscle oils, in beautiful bottles, with attractive labels, selling for one dollar an ounce, often contain only castor oil and a little color and perfume!

THE better makers of cosmetics know these things. They have in some cases been forced, or at least have felt compelled, to make unwarranted claims for their products because of the manifestly unfair competition of gentlemen of the cosmetic underworld who made the business a racket, and whose activities will be curbed by the revised Food and Drugs Act. It is for this reason that the industry as a whole backs the bill. True, there are occasional excited protests, like that of the half-hysterical speaker who recently declared that the new bill compelled cosmetic manufacturers to put vitamins in lipsticks. He had half heard a talk on the bill and had later scrambled allusions to nutrition with statements about cosmetics. The bill actually combines increased consumer with increased producer protection, the former being protected from poison and the latter from unscrupulous and unfair competitors.



Koremlu was only one of a number of hair removers which contained thallium acetate and caused very serious trouble

Turning to drugs: Just what reason is there that Glauber's salts, the purgative usually given to horses, should be exploited under a trade name as a remedy for kidney trouble, rheumatism, indigestion, high blood pressure, arthritis, faulty elimination, acidosis, and all the ills of increasing age? What further reason is there that the public should purchase a pound package of these magic salts for $1.50 when they can go to the drug store and get Glauber's salts for 40 cents a pound or, better still for humans, Epsom salts at 9 cents? There just is no sense to that.

Why should unfortunate sufferers from diabetes be permitted to waste their substance to the extent of 12 dollars a pint bottle for an extracted concoction of a common weed, horsetail, that grows along railroad tracks, which, in spite of its jocular name, is known to scientists as containing no medicinally active ingredients? Why should the victims of tuberculosis of the lungs be additionally victimized by a heartless corporation which recommends to them as a cure for their ailment a common horse liniment composed of well known and quite ordinary ingredients? Why should the obese be persuaded to buy a fat reducer guaranteed to be harmless but which contains actively dangerous thyroid substance as well as portions of a certain seaweed long used in Ireland to fatten hogs?

Under the present law these are all remedies for disease, except the anti-fat preparation—for excess fat is not legally a disease: it is simply a social handicap. The labels of these preparations are blameless. Not one label makes extravagant claims. But their general advertising is quite another thing, especially over the radio. In other instances a properly labeled box of Epsom salts may be shipped in interstate commerce quite legally labeled, but when it arrives at the druggist's it is placed in a holder, shipped separately, on which there are printed curative claims from anemia to zoomorphism and from cancer to club-foot. There is no scientific justification for that. It is not ethical business. Why tolerate it? What reputable manufacturer would want it tolerated?

IT is true that some reputable manufacturers appear to be opposed to the Copeland Bill. This is not to be wondered at when one considers the fairy tales they have been told about it by those to whose interest it is to have the bill defeated. They have been told seriously that the bill is designed absolutely to prohibit self-medication. This is absurd on its face. As long ago as 1913 the *Journal of the American Medical Association* itself affirmed the right of laymen to treat themselves with home remedies for minor ailments, and Dr. Arthur J. Cramp of that Association reaffirmed this in a magazine article in 1933. You cannot stop people from trying to treat their own ailments, but you can go far towards making that self treatment foolproof.

Anyone who reads the Copeland Bill will find that it goes into great detail about the labels for proprietary remedies. These labels must be fully informative. They must state that the remedy is a palliative and not a cure, when it is not a cure. They must carry warning statements about hypnotics and habit-forming agents. They must list all dangerous drugs. The manufacturers of proprietary remedies must not advertise them for the treatment of a long list of diseases for which science knows that it is dangerous to have laymen treat themselves. No false or misleading curative claims can be made on labels. It is quite obvious that all this discus-

sion is in the bill not because doctors need such information about proprietary remedies.

The whole bill is predicated upon a continuation of self-medication but it tries to make self-medication foolproof by giving the ordinary lay consumer the same information about the remedy that a doctor would have. If science knows that saline laxatives are not remedies for the diseases of old age, that horsetail is not a remedy for diabetes or a common liniment for tuberculosis, and if a mixture containing thyroid or thallium acetate is not "safe and harmless" to use for obesity or excess hair, why should not the layman have the benefit of that scientific information? The Copeland Bill will, if passed, merely make the fruits of scientific knowledge so accessible that laymen can use them almost automatically.

TODAY the horsetail diabetes remedy is freely sold because the Government, in bringing its case, could not prove that the therapeutic claims made on the label were "false and fraudulent." There was no shadow of doubt but what the claims were false. That was proved. Horsetail was not a remedy for diabetes. But fraud could not be proved because it could not be shown that the manufacturer knew he lied when he affixed such labels to his product. Under the Copeland Bill it will not be necessary to prove intent to defraud in such instances. The mere fact that a curative claim is false and misleading will be sufficient and, in the name of scientific research and the boons it has given us, why should that not be sufficient?

In the matter of foods the Copeland Bill will establish standards. Today there are no legal food standards except for butter and a few canned products, the latter having been enacted at the demand of the canning industry itself. Tomato paste may contain 12 or 22 percent solids; "maple flavored" sirup may contain less than 2 percent maple sirup, only a trace of ordinary sugar, and about 98 percent corn sugar; jam may contain 22 in lieu of 45 percent of fresh fruit, and the same holds for preserves; oysters may be soaked till they contain an inordinate quantity of water, and ice cream whipped until it is little more than well threshed atmosphere. These practices cannot be stopped today because we have no legal food standards.

The Copeland Bill will remedy that by establishing standards for foods. It will go far toward protecting public health by demanding that health foods really be health foods, or else quit claiming that they are, and also by establishing poison tolerances. Under the present law the Government must, each time it prosecutes, bring expert testimony to show that some specific lot of food may be injurious to health because it contains an added (not a naturally occurring) poisonous or other deleterious ingredient. Under the Copeland Bill the minimum (harmless) tolerances of various poisons in foods will be established by taking a poll of poison experts of the country, and violation of that standard will be illegal *per se*. In some cases, of course, the presence of poison will be totally prohibited; there will be no tolerance. In

Some hair dyes containing lead have caused users intense suffering

other cases, if it becomes necessary in order to protect the public health, the Government can force certain industries to operate under a license and permit system.

"But this is autocracy. It gives the Secretary of Agriculture and certain bureaucratic underlings absolutely dictatorial powers!" Your exclamation has been made before. It has actually been said that under the bill the food, drug, and cosmetic industries would have no recourse at all to the courts in questioning the decisions of Department officials, and that the word of such officials "becomes the law of the land." This is ludicrously absurd. Any such bill would be unconstitutional forthwith. Court review will occur if the bill is passed, just as it does now, for the interpretation of our laws is made by the courts, not by Government officials or even by scientists. In many cases the bill would merely enact into law what are common procedures today; in others it would tighten loopholes in the old law, many of which have appeared because of the inevitable progress of science during the past 27 years.

Suppose the bill became law. A manufacturer desires to market a common horse liniment as a cure for tuberculosis, a horsetail concoction for diabetes, or a food containing too much of some poison. He can go ahead and make a try at it. But, since the scientists who have studied tuberculosis, diabetes, and poisons all their lives know that these products are worthless or harmful, and since these expert opinions are on record, why do so? Appeal may be had to the courts, of course. The scientists would be called as witnesses. But if that happened today you would find no scientists willing to testify in favor of such remedies. Yet court review is perfectly possible under the new bill. But no Department of Agriculture czar would dictatorially make the law. The truth that science had already ascertained would be the real criterion of final judgment.

NATURALLY this bill has enemies. Many of them are sincere. Some of these have been misinformed by hysterical objectors whose disregard for fact is notorious. Others have positive reason for objecting to certain provisions of the bill and, in their excitement, attack the whole thing rather than seek to have the particular defect remedied. Doubtless, as the hearings on the bill proceed, the hostility of many of these objectors will be mollified. Others still object because they hold that they have themselves been anointed of the Lord to represent the consumer and, as missionaries to the lowly guinea pigs, they alone should be permitted to write and to dictate the enforcement of the law. However, the law can no more be turned over to them than it could be turned over to the American Medical Association.

All in all this is a good bill representing a sincere effort on the part of broad-minded idealists to protect consumers from fraud and harm, and reputable manufacturers from unfair competition, while interfering with legitimate business as little as possible in order to accomplish the desired ends. Years ago Dr. Harvey W. Wiley held hearings on enforcement policies for the then new Food and Drugs Act. That was in 1906, and he then made it plain in New York City that enforcement policies would be designed to protect consumers effectively with as little disturbance to business as possible. In 1908 he reported that he was more than pleased with the sympathetic co-operation of business men and manufacturers in their compliance with the bill. Dr. Wiley's policies have never been changed, and it can be said without fear of contradiction that no reputable and scrupulous manufacturer has a thing to fear from the Copeland Bill. Indeed he has a great deal to gain from its passage. To say that its passage would greatly benefit consumers is simply to state the obvious.

ELONGATING LEGS BY SURGERY

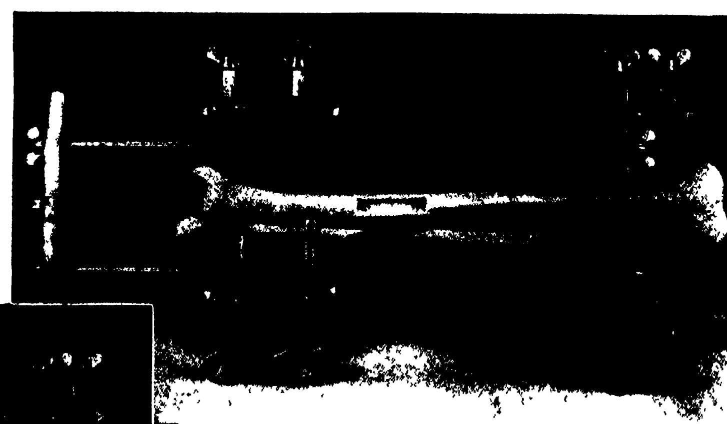
THE advances in orthopedic surgery in the last 25 years, and even in the last decade, have been very great. These operations are highly interesting and are not chronicled as freely as they should be in the public interest. It is now no longer necessary to go through life with one leg shorter than the other. It seems that a short leg is one of the greatest terrors to most people, who have a great horror anyway of "becoming crippled." There are many causes for crippling disabilities, among them being infantile paralysis, tuberculosis, or any serious fractures or accidents which might result in the shortening of a limb. Is there a real remedy? Fortunately there is a good one, when practised by skilled surgeons who make orthopedic operations their specialty.

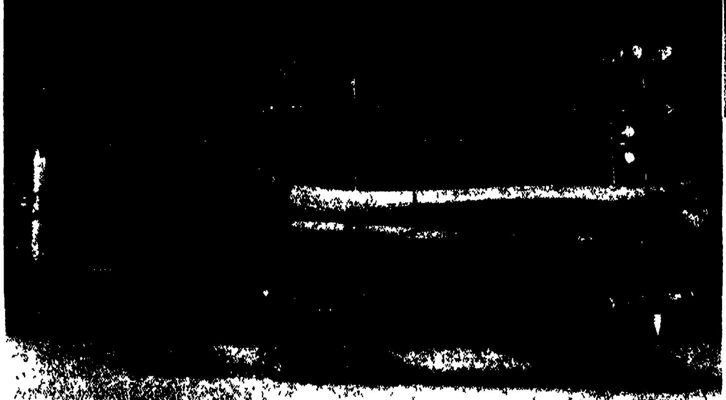
A demonstration set-up showing how high-speed rotary saw cuts bones after drilling

Hand drill for inserting wires in bones to be lengthened, developed by Dr. W. W. Burbank. The steel wires used for stretching are provided with drill points

Several years ago Dr. Leroy Abbott at present a resident of San Francisco, began experimenting with a process of surgical lengthening of the bones. The reason that such an operation had not been attempted previously was that bone, of all tissues of the body, is the most highly specialized and is therefore most damaged by any infection. This fear of infection, inherited from the pre-Listerian days, prevented progress until advances in aseptic surgery, particularly since the war, became so great that the percentage of infection has been immeasurably reduced and operative procedures of great complexity may be undertaken with full confidence of success.

The patient, fully anesthetized, is wheeled into the operating room where surgeons with their masks and gloves and nurses in similar garb stand guard against infection. The skin is cut away to the bone. The lining membrane of the bone is completely stripped away, together with all the attached muscles. The bone drill bores holes with wires which are left in place and held in adjustable clamps. Then with a rapidly rotated power saw the large bone, the femur, is divided in the fashion of an elongated Z or tongue and groove. The small bone —the fibula is cut diagonally. The wound is then closed, the clamps remaining in place until the patient recovers. Wing nuts serve to elongate the clamps gradually after the first day. Usually about one sixteenth of an inch a day can be gained without causing the patient undue discomfort. Nature fills in the gap as it is gradually opened by the clamps. The gain in length may be as much as two to three inches. We are indebted to the Hospital for Ruptured and Crippled, New York City, which we illustrated in our issue of September, 1930, and to Dr. Armitage Whitman of the surgical staff for the above information and the accompanying photographs.





Left: **Demonstration of bones ready for stretching**
Above: **How the adjustable clamp lengthens bones**

You Have

One Chance in a Hundred to Understand Einstein

By JOSEPH B. NICHOLS

Editor's Note: After preparing the accompanying article the author submitted it to Professor Einstein, with the following note:

"The enclosed article was written for publication in a magazine. If you find time to read it, I hope you will not find too much to object to. We have a maxim: that a cat may look at a king, so perhaps I can write concerning the renowned Doctor Einstein. At least you can smile at my 'cat-German.'"

Professor Einstein's reply, which he has given permission to translate and quote, was as follows:

"Thank God I am not a king, on the other hand you are quite an efficient cat. What you say against the legend of the unattainableness of the theory of relativity is as correct as it is useful. I believe that your figures give a good idea and contribute towards removing that detrimental and false faith in authority against which I have always fought to the best of my ability."

THE man whose wife doesn't understand him is too common to be of interest. A man whom nobody understands is, perhaps, a tragic case. (We couldn't know for sure, not being able to understand him.) But a man who is reputed to be understood by only a dozen men has captured the imagination of the world.

Everybody agrees that Albert Einstein is one of the great geniuses of all time. His researches in mathematical physics have revolutionized science. Their effect has not been on science alone; ultimately they will cause radical changes in many other fields of thought. However, when we try to find out what it is all about— just what changes are taking place in the theories of science and philosophy—most of us, after more or less reading, give it up and content ourselves with wondering about the simpler, but more insoluble problem . . . how Professor Einstein managed to get and retain such a wonderful head of hair.

Everyone who has mentioned Doctor Einstein or the theory of relativity has asked the question, "Is it true that only 12 people are able to understand the theory?" This estimate is usually attributed to Einstein himself. The last time this question came to my attention the number had fallen to six. There has not been any recent holocaust of the master minds of physics, so the decrease must indicate that six of the original group have decided that they didn't understand, after all.

The question, how many people can understand Einstein, is very interesting. It would seem that an answer (of a sort) can be arrived at. An exact result, whether six, or twelve, or twelve thousand, would be open to question, but at least we should be able to come to an approximate conclusion. As the scientists like to say, we can approach the proper order of magnitude. However, the matter is not too simple. We must first define just what we mean by "understanding Einstein."

THERE seems to be some fatality connected with popular explanations of relativity, leading its exponents to unbounded coining of paradoxes. This may be a reaction from the rigor of technical mathematics. Whatever the reason, the blight should not extend to a mere attempt to determine how many people are able to understand the subject. Still, according to the definition we choose, we may anticipate the answer to be, (*a*) at least 700,000; (*b*) perhaps 2000; (*c*) the dozen or so of the contemporary legend; and (*d*) none.

If, by an understanding of relativity, we mean such a complete knowledge of the subject that all its implications and effects are explicitly in mind, the fourth answer is correct. I am sure that Professor Einstein would be the first to agree with this conclusion. If such complete comprehension were possible, it would imply that relativity, as a branch of science, is complete, finished, and sterile for any future purpose. It would have no more worlds to conquer. Who would then care to study it? Let us pray that the doom of perfection may never descend on such a promising subject.

However, if such comprehensive knowledge were attained, by a single master mind or by thousands, there would be no way of proving the fact. Even much simpler conceptions, apparently set out on unassailable foundations, have ultimately gone to ruin. For example, consider the position held for centuries by the geometry of Euclid, based on axioms so self-evident that to ask for proof would be considered a sign of a vanishingly small I.Q. Relativity has risen on the wreck of the axiom of parallels.

Evidently there is a relativity of knowledge, as well as a knowledge of relativity. Perfect understanding is unattainable; therefore, a definition must be a matter of degree.

Suppose we take a definition which will lie within the range of the human mind, and estimate, if we can, how many may perhaps understand almost as much of relativity as Einstein himself. The number of men included in this group would be very small; perhaps, at the lowest, the mighty six, whoever they may be, and at the most liberal estimate, not more than two or three dozen. They would be men of surpassing ability, who have given a lifetime to the study of mathematical physics. Had there been no Einstein, it is possible that one or two of these men might be capable of that last stroke of synthesis which resulted in the doctrine of relativity. Einstein does not work in a mental vacuum; the problems which he studies are also being probed by others, and the findings of all are pooled in the general fund of knowledge. Besides, though an illuminating idea may wait for generations for some genius to discover it; after that genius has once announced it, it appears to those who are prepared as very understandable. Our group was ready to accept and appreciate relativity as soon as it was formulated.

WE might even feel some confidence in naming a few candidates. Surely Lorentz, Weyl, Eddington, de Sitter, and at least a dozen others who have made contributions directly in this field, as well as men like de Broglie, Dirac, and Heisenberg, who are working along other lines of physics requiring fully as advanced mathematical equipment and scientific knowledge. And we have said nothing of the group at the California Institute of Technology, whom Einstein has recently visited, nor of the scientists at Mount Wilson.

These are the men who form the basis

of the "dozen" legend. To them, relativity is of direct professional interest. Had the doctrine of relativity no implications, by reason of its novel treatment of space and time, for the philosopher and the philosophically minded layman; that is, if Einstein had put his system forth merely as the theory of tensors applied to certain phenomena of electrodynamics, these men would still have been interested.

HOWEVER, these are the men who *do* understand Einstein, in the fullest sense possible in this imperfect world. Our question was: "How many can understand?" How many, we may say, given the same training as these men have received, would be in the same position? The number of mathematical physicists is limited by the all-pervading law of supply and demand. The world can support only a certain number of research specialists. While great mathematical ability is essential, it is not the sole factor determining who these men shall be. We can speculate that the leaders in other fields of science—chemistry, geology, pure mathematics, or engineering—might, if their interests and opportunities had taken a slightly different trend, have been among the group considered above.

Now, let us limit the question a little more. The small group we have just enumerated should be expected to be at the forefront of all the latest developments; to be able to assimilate each new advance as soon as it is announced, as well as to contribute a share. But it would be unfair to say that no one can understand relativity unless he gives a whole lifetime to its study.

In 1916 Professor Einstein published a paper entitled "The Foundation of the General Theory of Relativity." This was the epoch-making document which, after the close of the World War, brought the author to the attention of the general public. In it tensors are applied to the formulation of natural laws; the new law of gravitation, which includes Newton's law as a first approximation, is deduced; the abnormal behavior of the orbit of Mercury was explained; and the bending of rays of light passing near the sun, to confirm which scientists have gone on expeditions to observe recent eclipses, was predicted. If a student can read this paper, can follow the reasoning and understand what it is all about, surely he can be enrolled among those who understand Einstein; as of the date 1917 at least, if not perhaps as of 1933. At any rate, he will know more than most of us do.

The graduate departments of the leading universities offer courses in relativity, and it is possible that many of the students who take these courses obtain a good understanding of the subject. It is very improbable that all do. Strange as it may seem, to people who are not well acquainted with universities, it is even not impossible that some of these courses may be presented by professors who do not themselves understand the subject. However, there is a high degree of probability that the professors do know what they are talking about, and that quite a number of the students manage to gain that understanding. Since 1920, it is inconceivable that a large percentage of graduate students have been able to obtain the degree of Doctor of Philosophy in either physics or mathematics, without being conversant with the general theory of relativity.

IN the period between 1920 and 1930, according to statistics compiled by the National Research Council, the various universities of the United States conferred the degree of Doctor of Philosophy on 603 candidates in the field of physics, and 392 in mathematics. Practically 100 per year. Let us be conservative and estimate that not more than 500 of these erudite doctors studied relativity. There would still be quite a number of graduate students who have failed to take the degree, but who may have mastered the mathematical theory of relativity. And it is possible that a few of the crop of Ph.Ds prior to 1920, and not included in any of our lists heretofore, may have mustered up enough energy to study the subject. And these figures are for the United States alone. There are scientists and graduate students of science in England, in France, in Italy, in Holland, in Norway, in Japan. And, of course, there may be a few in Germany. It would be sad to think that the untranslated papers of Einstein can be read understandingly only by those who have acquired German as a second language in order to be able to read the works of Einstein and a few others who are included in the group of mighty men we discussed at the beginning. When we say that at least 2000 understand relativity, our estimate is really too modest.

The impression that one receives, on hearing that perhaps only a dozen men are able to understand relativity, is that the material is so recondite, so difficult, that only a very few persons possess the intelligence necessary to grasp it. It is not a matter of acquired training and education, but of hereditary mental power. There is a certain degree of truth in this point of view, but it is not the whole truth. If we agree with the majority of psychologists that intelligence is, in the individual, a fixed quantity, we should expect that not everybody would possess a sufficient amount. In fact, a great many persons, even some who are fairly successful in many ways, are unable to master the abstract reasoning required for ordinary high-school mathematics. However, the adepts of relativity have no monopoly of intellect. The publicity given to the subject and the interest aroused have been due to its implications for philosophy, and also to a large extent to the personality of its founder. Fully as difficult to understand, and as significant to science, are the quantum theory, wave mechanics, statistical mechanics, chemical thermodynamics, colloidal chemistry, and a host of other subjects. Perhaps only a handful, a couple of dozen, will become experts in any of these branches. The highly learned will be only a select few, but we cannot justly single out the votaries of any one branch for special honor.

So, in considering how many have such native intelligence that, given the special training, they would be able to swell the ranks of, say, the 2000 plus, if not of the two or three dozen, we have, to begin with, those who belong to the similar throngs who are versed to an equal extent in these other subjects. There would be some overlapping, but we should be able to include at least another 2000 plus from each of the other major branches of science. In the last decade, while approximately 1000 doctorates were conferred in physics and mathematics, the total number of doctorates in science was over 7000. We should be safe, then, for this last estimate, in using the same propo tion and saying that at least 14,000 could qualify. But this is just a b ginning.

IF our social system were such that every individual received the education which he is capable of mastering, the matter would be very simple. We could assume that every graduate student of science would be of the necessary caliber. However, we know that many students manage to get admitted to graduate schools without being overburdened with intelligence. In fact, I would even venture the sacrilegious statement that some such have emerged with the precious doctor's degree. On the other hand, the factors which may debar intellectually qualified individuals from pursuing graduate work, or even from attending college, are numerous and varied. For example, there are financial reasons. At any rate, there is a lack of opportunity for many—how many, we can only guess. Consider that in 1930 the universities of the United States conferred 1055 doctor's degrees in science. In 1900, the number was 102. No one would claim that the number of people with the raw intelligence presumably necessary for a prospective doctor has increased tenfold in 30 years, nor, seriously, that the intellect required of a candidate has been reduced. The in-

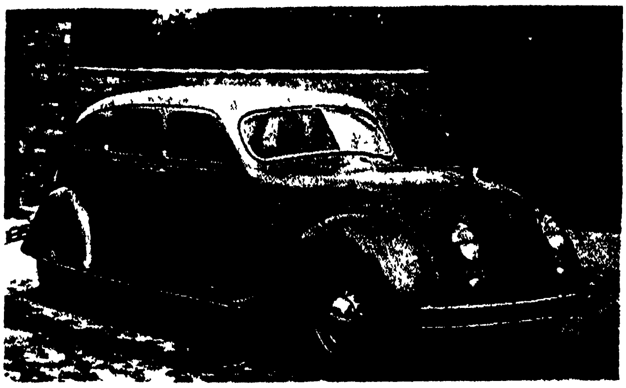
(*Please turn to page* 107)

"Malnutrition" in the British Navy

In view of the naval building program recently begun by the United States as a method of relieving unemployment, and because this country is far behind the allowable quota of ships under the naval treaties, the above illustrations are of interest in showing the deep concern with which the British Empire views the question of fleet strength. Like ourselves, the British feel that many of their ships are out of date. We are inclined to agree that, if the claims are fully substantiated, the British Empire will be faced with the problem of finding vast sums of money for new construction at the expiration of the present treaties on December 31, 1936. It must be noted, however, that the British fleet at present exceeds in tonnage that of the United States, while the question of relative obsolescence of the two fleets is open to some argument. Japan's fleet has been built to within a few thousand tons of the allowable limit; and since the majority of her vessels are of recent construction, her fleet is in excellent condition. From our knowledge of our own fleet's deficiency and judging by the British claims depicted above, there is no question that much naval building and organizing of auxiliary services will be necessary before the expiration of the present treaties if there is to be any serious consideration of an extension of treaties. It is sincerely believed that such an extension is necessary in order to prevent competition in naval building and the mistrust of motives which so often has led to war.

STREAMLINING AND YOUR AUTOMOBILE

By ALEXANDER KLEMIN
Daniel Guggenheim School of Aeronautics
New York University



An experimental model of a streamlined car (see also Figure 10) produced by a well-known manufacturer

Much Greater Gasoline Economy May be Expected When Motor Cars Are Really Streamlined. The Facts of the Matter, in Non-Technical Language, Are Presented in the Accompanying Article. Will Motor Car Manufacturers Meet the Demand for Greater Efficiency by Producing Automobiles Planned by Airplane Designers?

THE familiar automobile, when moving at today's normal speeds, exerts more power to overcome air resistance than to conquer ground friction. Yet motor car streamlining has hitherto been almost neglected by manufacturers. Speed has been achieved by mere application of brute power—and tremendous wastage of gasoline.

Of course we have had with us, all during 1933, cars labeled "streamlined" for advertising purposes. To tilt the windshield a little more rakishly, to give the radiator a push and the rear end a pull, did not make a 1933 streamlined car out of a 1932 model. One should, of course, feel somewhat lenient toward the manufacturers. To produce a real streamlined car commercially would mean scrapping an enormous investment in dies and machinery. And to dare so far would require perfect confidence that buyers would take kindly to the new shape when they saw it. Manufacturers have had good reasons for going at the thing slowly—for playing safe—for trying out public acceptance by degrees. Such questions of policy are for business men to settle. The engineers are quite certain that vast improvements in efficiency and speed are possible by streamlining the automobile, but maintain that real departures from present forms are necessary.

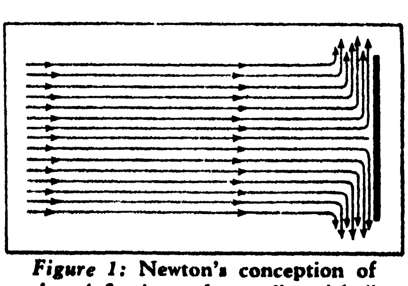


Figure 1: Newton's conception of the deflection of air "particles"

Man has long known, of course, that the air—though invisible and thin—nevertheless has definite weight, and the ability to resist the motion of any body moving through it. But the explanation of this air resistance or drag has not been so plain; it has occupied some of the greatest minds of the last two centuries.

Sir Isaac Newton, who propounded so many mechanical laws that stand to this day, considered the air as being composed of many individual particles which behaved like little bullets or pellets. When particles of wind struck a flat plate held at right angles to the wind's direction, they were then (said Newton) deflected at right angles to their own direction of motion. (See Figure 1.)

FOR once Newton, the discoverer of the laws of gravity, was wrong; his conception was erroneous, and the values he gave for the resistance of various objects were too high. Partially, however, he was right: he showed that air dislikes abrupt deviations and sharp corners.

It is not an accident in nature that fishes which move fast in pursuit, or in avoidance of pursuit, are all of the shape which we have learned recently to call streamline. Nor can evolution have been blind in giving bodies of similar outline to the fastest flying insects and birds. When a fluid parts to make way for such a streamlined shape, this fluid (whether air or water) meets with no sharp corners, and follows the curved contours without any sharp changes in direction or motion.

It is true that the air which comes in actual contact with the very surface of a moving body is brought to rest, and also that the fluid which is at a little distance from the body is somewhat slowed down. (The result is the same whether we visualize the air moving and the body at rest, or the reverse.) Naturally this produces some little drag on a moving body, for slowing up the air-flow means expenditure of energy. This phenomenon, known as "skin friction," is unavoidable no matter how smooth and polished the surface. It is, however, of small practical importance.

The important fact is that the air flows smoothly almost to the very tail or stern of the streamlined body. (See Figure 2.) It is only at the very tail that a few eddies or whirls are produced.

Next to this natural stream-lined form, which has been adopted exactly for airships, comes an oval shape. Here the air-flow is rather more disturbed. The swirls at the rear set up a partial vacuum which acts as a definite brake on the forward movement. To meet the same slight air resistance as that of a completely streamlined body of a certain size, an oval object would need to be much smaller.

The third, or egg-shaped form, with its longer axis at right angles to the wind, has to be still smaller if it is to offer no more resistance when in motion than the streamlined shape. The air eddies quite roughly in back of the body.

The last of the four bodies to be con-

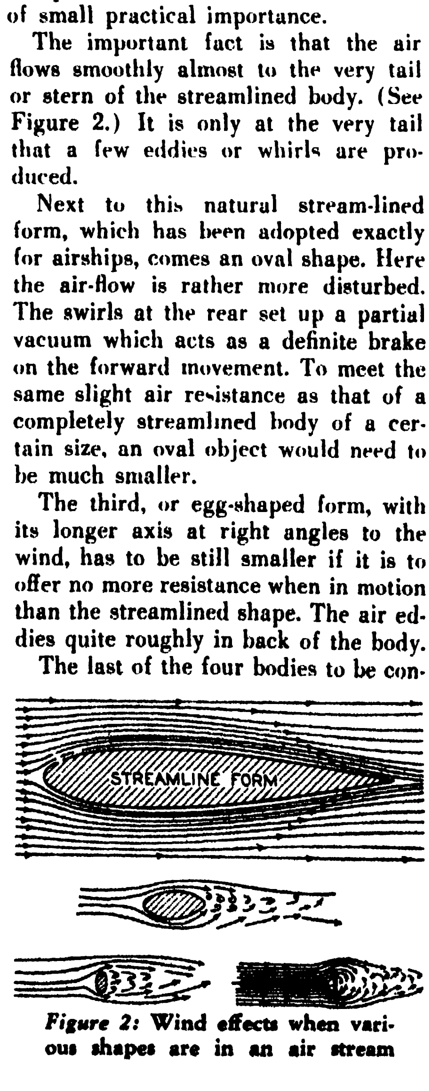


Figure 2: Wind effects when various shapes are in an air stream

sidered, and the one offering the maximum of resistance, is the flat plate. Here the flowing air encounters two sharp corners. On the windward side the air-flow is fairly smooth. But on the lee-ward side eddies and whirls continuously form and reform, and a constant expenditure of energy is needed to overcome their action. The flat plate has to be very tiny indeed if it is to be propelled through the air with the same amount of force as is required to move the streamlined object.

THOUGH air is relatively light in weight (a 28-inch cube of air weighs only a pound, while the same volume of water would weigh 100 pounds, and of steel 784 pounds) the force of air in motion may be enormous. We all know the power of the wind when it rises to cyclone velocity. We may even take a more homely example: A man is holding an umbrella in a 60-mile gale (Figure 3.) The umbrella creates even more resistance than a flat plate, for not only does the air swirl in back, but it also piles up and swirls on the umbrella's windward side. With an umbrella 3 feet in diameter, the man actually has to exercise a pull of 85 pounds. Other simple tests of wind power can be made by opening the door of an automobile that is moving very rapidly, or by swinging out a garage door in the face of a storm. An Atlantic liner in a gale may be slowed down from some 25 miles an hour to as little as 10 or 12, and a large portion of this retardation will be chargeable to the power of the wind on the superstructure of the ship.

Lord Kelvin, great British scientist, has rightly said that "to know, one has to measure." Without becoming too involved a reader untrained in mathematical mysteries can understand how resistance is gaged in aerodynamics.

If, for example, our flat plate is held square against the wind—*i.e.*, facing the

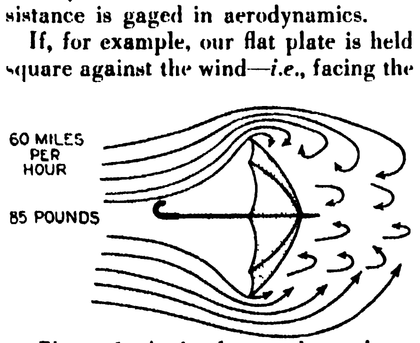


***Figure 3:* A simple experiment in wind resistance, described in text**

wind—on what factors will the resistance depend? And how will this resistance vary with speed and areas?

First, we find it simple common sense to say that the resistance will vary directly as the area; as the area of the plate is increased, it is obvious that the resistance will be greater.

Second, we find resistance depending on the speed of the wind; the faster the wind, the more air will strike the plate in a given time. Likewise, the faster the flow of the air, the more velocity it will lose in striking the plate. Here we have a double effect, due to only one cause. Hence this drag will be proportional, not to the speed alone, but to speed times speed. We can say, therefore, that the resistance varies with the square of the speed. Note here, in passing, that

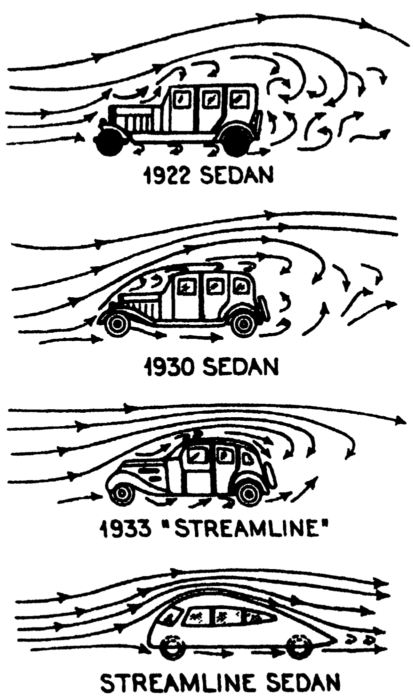


***Figure 4:* A comparative study in air currents around auto bodies**

it is because resistance varies with the *square* of the speed that the streamlining of automobiles becomes of such vital interest and importance when higher speeds are considered.

Third, and finally, resistance will depend upon a factor which we may call K, which is a *constant* representing the shape of the body. This always has to be experimentally determined.

We are now ready to make an equation:

Resistance=K times (*Area in Square Feet*) times (*Speed in Miles per Hour*)^2.

For a flat plate, K equals .0032. We are now ready to do an example in arithmetic. Problem: What is the resistance of a flat plate which is ten square feet in area, in a wind 100 miles an hour?

We take our constant K of .0032; we multiply it by 10 for the area; we multiply again by 100 squared for the speed; and we find the answer is the enormous value of 320 pounds. This is the force exerted against the flat plate.

We shall study presently the corresponding coefficient for the automobile. The equation for the plate shows, however, that we can reduce the resistance of a given body in a given airspeed only by changing one of two factors: either K, representing the shape, or the area.

Now in an automobile it is hardly practicable to reduce the area. The frontal or projected area of the car is largely determined by factors outside of the designer's control: just so much space, headroom, and comfort must be provided for the passengers.

Aerodynamic streamlining of the automobile means, therefore, a changing of the shape—giving the car such a form that K is reduced in value. If K goes down, the resistance goes down, and the power expended to overcome air resistance decreases likewise.

It is to aviation that we owe our greatest debt for present-day advance in our knowledge of aerodynamic engineering. The automobile, of course, was hitched directly on to a horse-and-carriage age; no one ever gave a thought to getting through the air when the obvious problem was to get over the ground. That the first automobiles were designed like carriages was no more remarkable than the fact that they still are like them.

Aviation, on the other hand, started off with the problem of designing a new vehicle for travel in an entirely new element; it had no precedents of design to follow; and even the first airplanes

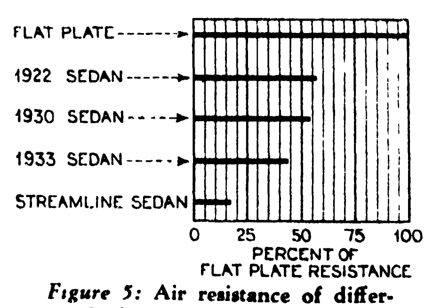


***Figure 5:* Air resistance of different bodies compared with a plate**

incorporated certain elements of aerodynamic design—understandable when we remember that the Wrights made all their calculations from wind-tunnel tests.

The research in wind tunnels has continued ever since. Compare the early Wright biplane, seen through its many exposed struts and wires, with a modern transport ship having retracted landing gear, complete absence of exposed wires or struts, and a close approximation to a flying wing.

In the year 1915 the Schneider Trophy race was won by a seaplane having 160 horsepower at a speed of 60 miles an hour. In 1931 the race was won by a seaplane at a speed of 340 miles an hour. If there had meanwhile been no change in the art of streamlining and designing planes, the horsepower required by the 1931 ship would have been proportional to the cube of the ratio of the speeds. The horsepower would have been $(340/60)^3 \times 160$, or

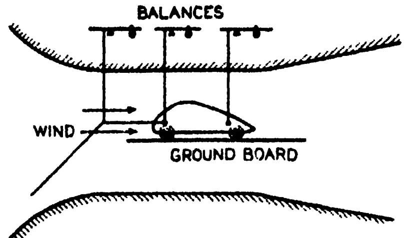


Figure 6: **How model car bodies are suspended for wind tunnel tests**

29,200 horsepower,* but the actual horsepower used by the 1931 racer was only 2300, or about one thirteenth of the preceding figure.

One very important fact discovered in aviation is certainly not utilized even by the makers of these recent "streamlined" cars with ornate headlamps and fenders. It is a curious thing that minor projections or excrescencies on a moving body may cause two and two to become seven. If, for example, we take a perfect airship form, and then mount upon it a small projection of comparatively minor resistance value by itself, the combination resistance may be more than doubled. This is caused by the interplay of the two groups of disturbed air currents. Of this factor the designers of recent automobiles seem to have taken little cognizance. Though the basic shape of the car might indeed seem slightly improved, the flow of air is impeded just as much as ever by fenders, mudguards, headlights, spare tires, and misplaced radiators and driving gear under the car.

ALL of this is easily demonstrated by wind-tunnel tests. A wind tunnel (Figure 6) is, in effect, a huge wasp-like tube, with windows in the sides, through which air is drawn by a giant propeller placed at one end. A board is placed in this tunnel to simulate the ground. On this is placed the automobile model, which in turn is connected by wires to the ceiling. The forces exerted are measured through these wires on very delicate balances mounted above the roof of the tunnel.

The result of tunnel tests on four different types of cars is interesting. Of these one was an early 1922 model, one a typical 1930 sedan, one a so-called streamlined car of early 1933, and the fourth an automobile actually streamlined in accord with aerodynamic principles. (Figure 4.) It is true that the air flow around the 1933 model proved slightly less disturbed than around the 1922 model—but only slightly. Below are the results listed in tabular form; in graph form, they are shown in Figure 5. The first column gives the value of K, which it is so important to reduce if we are to avoid great power wastage. The second column compares this value of K, in percentage form, with the same value for the flat plate previously discussed. Note that a 1922 sedan had 56 percent as much air resistance as if it had been a flat plate! Furthermore, the 1933 sedan was only 11 percent better!

Description	*Value of K*	*Percent of K for flat plate*
A flat plate	.0032	100
Typical 1922 sedan	.0018	56
Typical 1930 sedan	.0017	53
"Streamlined" 1933 sedan	.0014	44
A scientifically streamlined automobile	.0005	16

These values, let us repeat, are not mere estimates; they are derived from careful experimentation in the wind

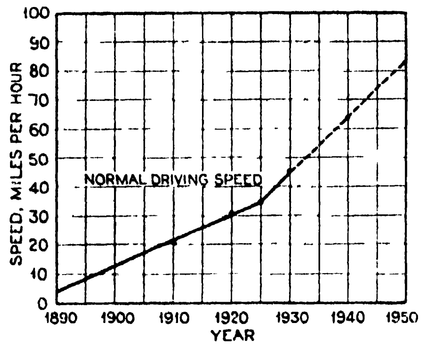


Figure 7: **Normal driving speeds have increased and will continue up**

tunnel, where very accurately scaled models of the automobiles are used. The figures are therefore based on the very best data that modern science can supply. Nothing remains but to admit that in 1933 the applied science of automobile streamlining was still in its infancy.

If we are going to estimate the operating cost in fuel, and in dollars, of these automobiles that are only 50 percent better than flat square plates, we must know something about normal speeds. We are not concerned with the top speed of a car. It is the speed on the open road in ordinary driving, the speed which the driver—after more or less experimentation—finds best suited for his purpose. How this normal driving speed has varied with the years is hard to estimate; we may at least be sure that it has steadily increased. Figure 7 is the result of a wide inquiry on the subject made by a prominent automotive engineer whose researches can be regarded as quite reliable. It indicates that the normal driving speed for the year 1933 was 50 miles an hour. With better roads and additional "super" highways, it seems only reasonable to assume that speeds will continue to increase, and that by the year 1940 the average driving speed on the open road will be 64 miles an hour. How are the automobile designers going to meet this high-speed challenge? Merely with more powerful engines?

On a level road there are two major resistances to be overcome. One is the rolling resistance; the other, the air resistance. The air resistance we have already calculated for a conventional car of today. The rolling resistance is even more easily ascertained.

The rolling resistance is due to such factors as friction in the wheel bearings; friction in the tire walls; deformation of the road surface; loss in the transmission, and in the final drive. It may be very accurately determined on a chassis dynamometer, an instrument known to all automobile engineers. Here the car is mounted on an endless belt, to simulate rolling over the ground; the draw bar pull and the engine power are simultaneously measured.

WE HAVE already seen that horsepower required to overcome air resistance increases as the cube of the speed. Horsepower needed to overcome rolling resistance increases directly in single ratio as the speed. Total horsepower required would be a combination of these two factors, and increases very rapidly as speeds increase. (The curves reproduced here apply only to high-gear conditions.) The engine of the car at full throttle can deliver, at any speed up to top speed, a power much greater than the total horsepower required. But, when the curve of maximum available power and of total resistance power meet, we then reach the top speed, which cannot possibly be exceeded. Up to this point the excess power available may be used for overcoming a grade, or the effect of a powerful headwind.

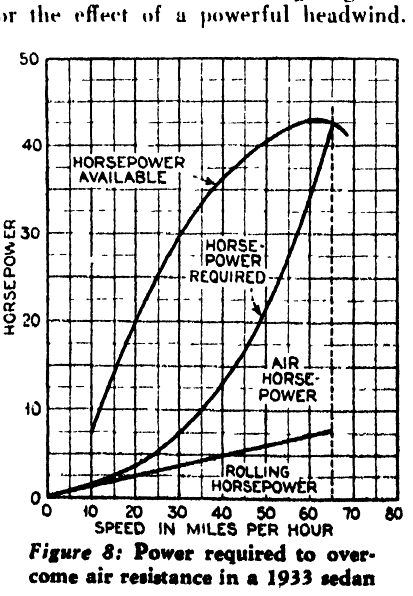


Figure 8: **Power required to overcome air resistance in a 1933 sedan**

***Author's Note:** It was previously shown that air resistance varies with the *square* of the speed. Power, however, is not only a function of the force exerted, but also of the speed at which the pull or push is being exerted. Thus, to estimate the horsepower of the work done, the air drag has to be multiplied again by the speed. Now, if we multiply the speed by the square of the speed, we get speed cubed. In short, horsepower required increases as the cube of the speed—still more rapidly than resistance, and still more forcefully so far as its argument for streamlining is concerned.

(See Figure 8 on the opposite page.)

Reduction of power expenditure needed for rolling resistance is largely a problem in reducing friction—never to be completely solved this side of perpetual motion. It is in reduction of power spent in combating wind resistance that the real opportunity for triumph lies. How much of the motorist's dollar is today being spent to make horsepower that will overcome air resistance? To average 50 miles an hour, he will apparently need 26 horsepower, of this amount 18.2 horsepower being devoted solely to overcoming air resistance. With the average engine, such total expended horsepower would mean a fuel consumption of 3.81 gallons an hour. Of this amount the air horsepower would be responsible for 2.66 gallons. At 20 cents a gallon this means a driver would spend, in an hour's traveling, 23 cents to overcome rolling resistance, and 53.1 cents to conquer air resistance. In other words, at only 50 miles an hour the average driver burns up 70 percent of his gasoline just to get through the air.

If, by 1940, true streamlining of cars has not been adopted, and if average speeds, as projected by present trends, reach 64 miles per hour, the total horsepower expenditure will then be 54. Trusting that gasoline remains at about 20 cents a gallon, the cost of transportation would become $1.62 per hour; of this amount only 31 cents would be devoted to getting over the ground. The rest would be expended on invisible air.

TRUE streamlining would save about 30 percent of our gasoline at 30 miles an hour (see Figure 9), and over one half of it at 60 miles an hour. Four or five years from now, with average speeds increased, the relative saving to the average driver will be even more striking.

It is possible that motor-car designers will still pursue the beaten tracks for customers, making minor modifications here or there, bringing out each new model with just a little change and a great burst of publicity.

It is also possible, on the other hand, that some pioneer will make a really determined effort to bridge with one leap all the unnecessary intervening steps, will scorn to put a few more horns on the horse, and will use our present store of aerodynamic knowledge to create the car outlined in Figures 10 and 11. (At the time of going to press with this number, it appears quite likely that at least one or more manufacturers will bring out in 1934 cars that approach the form shown in Figure 10. In fact, models of this design have already been produced. *The Editor.*)

In Figure 10 is the laboratory con-

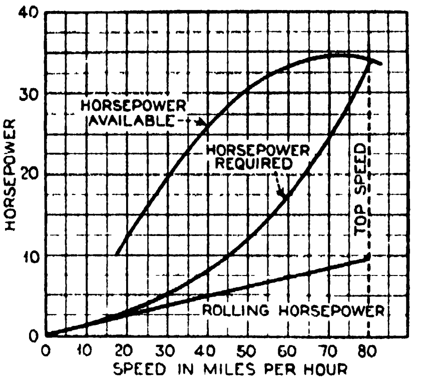


Figure 9: **In a really streamlined car, the power absorbed by air resistance is reduced. (See Figure 8)**

ception of the ultimate in streamlined cars if present basic construction is maintained: that is, if the motor is kept in the front, the front wheels steer, and the rear wheels drive. As will be seen from the sketch, all sharp corners would be eliminated. There would be no fenders or running boards. The cooling radiator would be smoothly faired into the rounded nose, with air outlet ducts forcing the air to flow smoothly out of louvres underneath.

The hood would completely cover the front wheels and the engine. The nose would be rounded and shortened, permitting (on the same chassis length) an extending of the body in the rear and the inclosure there of the spare tires, trunk, and so on The body would be wide in front, and taper to the rear; there would certainly be room for three front passengers. Projecting accessories such as lights, horns, license plates, radiator caps, and so forth, would all be flush with the surface of the body. The only projections that seem absolutely necessary to maintain would be bumpers, front and rear.

In Figure 11 is outlined what seems to be the ultimate in streamlining. Here the conventional body construction is no longer followed. The motor will be in the rear, and the passengers ahead of the motor. There may be either three or four wheels, depending on whether a single or double wheel is used in the rear. If a single wheel is used there, the steering will be by this wheel. This three-wheeled arrangement will have certain maneuvering advantages over the other type.

From a purely aerodynamic standpoint this latter is the more efficient shape, but from other viewpoints it appears less practical than the car shown in Figure 10. The fragmentary data available indicate that the car of Figure 10 should have only 45 percent of the air resistance of the 1933 sedan. The car shown in Figure 11 will have about 36 percent of the same value.

IT may well be argued that buyers would not immediately accept this completely streamlined car; that they would not like its appearance, and that in general public aversion to change is too great. On the other hand, the public would very soon realize the saving in gasoline. And, since eddies and whirls would be eliminated, a great deal of air buffeting and vibration would also disappear, markedly increasing riding comfort.

The eye soon becomes adjusted to radical changes of the objects surrounding us. The car of 1922 probably appeared quite beautiful to the eye of its owner. The new completely streamlined car may, in a very short time, be quite as pleasing to the eye. It certainly will give more economy and more comfort. It remains to be seen how American designers will meet the challenge.

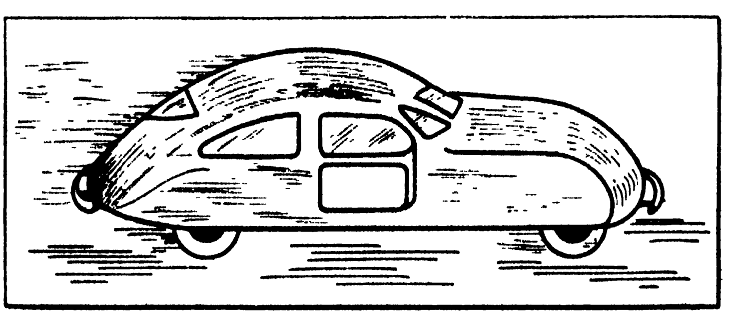
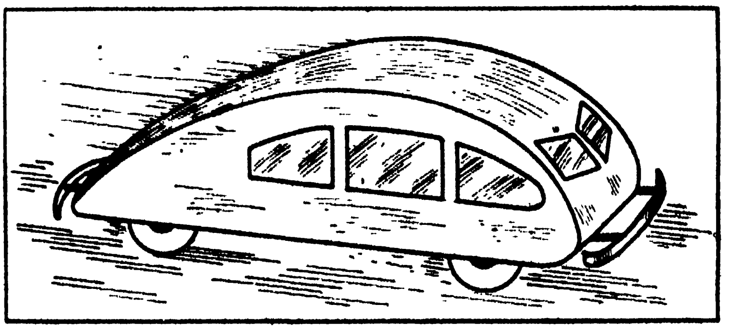


Figure 10, left: **The ultimate in streamlining with present basic construction.** ***Figure 11, below:*** **A more efficient streamlined design with the engine in the rear**



The New Telescope Mirrors

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
President of the American Association for the Advancement of Science

A LITERARY-MINDED student of the writer's once answered an examination question in the words, "Telescopes are of two kinds, refractory and reflective." Every one of the many astronomers who have chuckled over the story admits that the telescopes of his acquaintance have sometimes been decidedly refractory, quite independent of their optical systems; and an instrument which allows the astronomer to reflect is deeply welcome, though it may form its image by refraction.

Speaking more seriously, it would be hard to say whether the lens or the mirror is of the greater usefulness to the astronomer. In the long history of telescope making they have alternated in precedence. Newton's invention of the reflecting telescope furnished the first means by which sharp achromatic images of the heavenly bodies could be secured, and the refractor could not compete until Dolland designed the achromatic lens. The resources of 18th Century glassmakers, however, were unequal to the production of large homogeneous blocks, so that the first great telescopes were Herschel's reflectors. In the 19th Century the refractor forged ahead again and the reflector was neglected for a generation. Toward the close of the century modern resources of engineering and technique were for the first time applied to the construction of reflecting telescopes, with the results now known to all men, and there is no probability that refractors can ever be made which can compete in light-grasp with the great modern reflectors—though both types are sure to remain of permanent value. The reflector, owing to its smaller cost and more modest demands for housing room (for equal power), has become the favorite of the amateur observer.

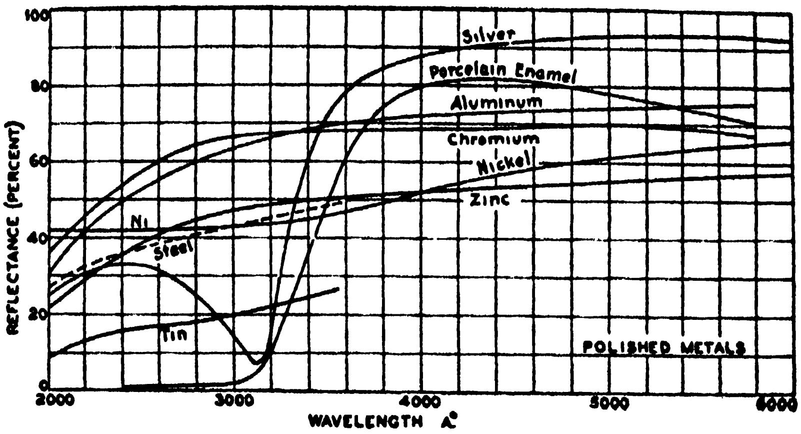
THE heart of a reflector telescope is the mirror and it is here that troubles begin, for no ideal substance for the construction of optical mirrors has yet been found or is in sight. The perfect material, which Dr. Anderson in an imaginative mood has called "mirrorite," must be rigid and permanent but not brittle or too heavy; must have a vanishingly small coefficient of expansion and conduct heat freely so that it shall not be distorted by temperature changes; must have a very high reflecting power for all wavelengths from the extreme ultra-violet to the infra-red; must be capable of being worked to an exceedingly accurate figure and retaining it for years without distortion or after-effects; and must take a high polish and retain it free from tarnish or stain under all the vicissitudes of the observatory or the laboratory. Such a miraculous combination of virtues is too much to hope for; we must be content with an approximation.

When it comes to metal mirrors, nothing is yet available that is much better than the speculum metal used by Herschel, an alloy of tin which takes and retains a fine polish but unfortunately is almost as brittle as glass. It is still generally employed for diffraction gratings and some other purposes, but for telescopic use it has the great disadvantage that any tarnish on the surface cannot be removed without re-polishing, with the accompanying danger of spoiling the accurate figure of the surface. Modern practice therefore tends almost exclusively toward glass mirrors.

Properly annealed glass is admirably rigid and permanent and can be cast in large masses. Its coefficient of expansion is lower than for metals and may be much reduced by the use of special glasses of the Pyrex type, and it takes and retains an excellent polish. Fused quartz is still better, but has not yet been successfully obtained in really large disks.

But the reflecting power of a bare glass surface is ridiculously low, so that it is of no use till it has been coated with a metallic film so thin that its presence does not spoil the shape of the surface. For many years the standard coating has been of silver. This can be easily deposited on a clean surface by chemical means. The amateur in his first trial may think the process complicated, messy, and anything but easy, but in expert hands it is all in the day's work. An imperfect coating can be dissolved off in a moment with nitric acid and resilvering begun.

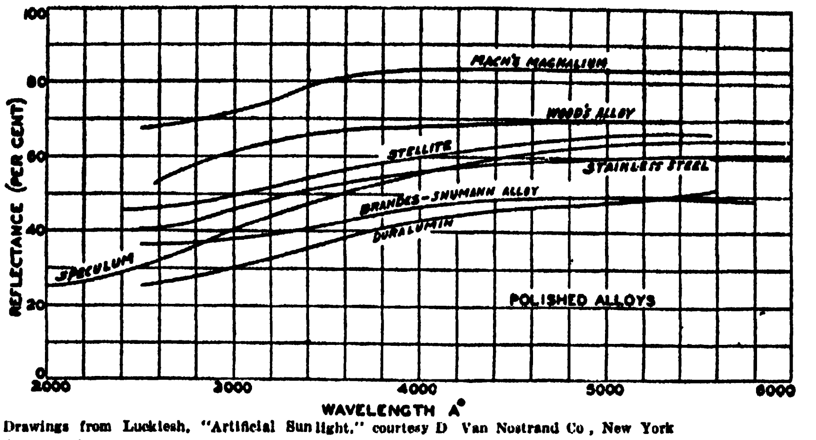
When the silvering solution has been washed off with distilled water the sur-



Spectral reflection of some polished metals. The figures, 2000, 3000, and so on, across the bottom, refer to wavelengths of the light, expressed in angstrom units (ten millionths of a millimeter). The visible spectrum begins at about 3900, at the end of the violet, and extends through the various colors as follows: violet as far as about 4300, blue to 4900, green to 5500, yellow to 5900, orange to 6200, and red to 7700, the latter extending off the present diagram to the right and the infra-red lying beyond that. The same diagram extends to the left beyond the limit of the visible spectrum (at 3900) as far as 2000 but, since the earth's atmosphere cuts off the ultra-violet waves shorter than about 3000 angstroms in length, the part to the left of 3000 may be ignored in connection with astronomical work; it is used in laboratories, where it can be created artificially The figures on the left side refer to the percentages of incident light reflected by the different metals—that is, the reflectivity or reflectance. Note how high the curve for silver stands throughout the visible spectrum but how rapidly it tumbles after the end of it at 3900. As Professor Russell states, silver films are actually transparent to waves of this length and silver mirrors are virtually useless for capturing the ultra-violet end of the spectrum of a star. The curve for aluminum pertains to ordinary aluminum freshly polished, not the vacuum-deposited kind discussed in the article. Even it, however, shows high ultra-violet reflectivity

face is dim with more or less of a "bloom," but this is removable by ordinary polishing.

A fresh silver surface has a very high reflecting power for visible light—fully 90 percent—but it has serious disadvantages. First, it is soft and easily scratched. Even polishing with the finest jeweler's rouge produces microscopic scratches which scatter light and make it hard to observe faint stars near bright ones. Secondly, it is very liable to tarnish. Even in the best atmosphere a silver coat deteriorates badly and has to be replaced in from six months to a year, and there is an important loss in reflectivity before this. Third, and most serious of all for the spectroscopist, the reflecting power of silver falls off very rapidly in the ultra-violet. Near 3100 angstroms it is only 5 percent—hardly more than for bare glass. Indeed, a silver film is almost transparent for such light and serves as an excellent color filter. For shorter waves the reflecting power gradually increases but is still low. On this account it is practically impossible to photograph the spectrum of a star with silver mirrors in the region below 3400 angstroms, and much detail of great interest lying between this and the limit set by atmospheric ozone at 3000 angstroms is inaccessible.



Drawings from Luckiesh, "Artificial Sunlight," courtesy D Van Nostrand Co, New York

Spectral reflection curves for polished alloys, after Hurlburt. Mach's magnalium has 69 parts aluminum and 31 parts magnesium in 100 (see "Amateur Telescope Making," page 317). Wood's alloy consists of bismuth, lead, tin, and cadmium. Stellite consists of chromium, cobalt, and tungsten. Stainless steel is usually 18 parts chromium, 8 parts nickel, the remainder iron. Brandes-Shumann alloy has copper 41, nickel 26, tin 25, iron 8, antimony 1. Duralumin has aluminum 94, copper 4, manganese 1, magnesium 1. Speculum metal has copper 68, tin 32, and is a very brittle, cantankerous alloy to deal with

A BETTER metallic film is much to be desired, and one with almost ideal properties has recently been found. It is of a familiar but most unexpected composition—aluminum!

We ordinarily think of aluminum as a greyish metal, and few of us have ever seen a highly polished surface—for if prepared in the ordinary way it tarnishes very rapidly. Aluminum, indeed, is one of the most active, chemically, of all the metals and no one would have expected it to give permanent mirror surfaces.

Success of course depends on finding the right way to put the aluminum on the glass. It is done by evaporation in a vacuum. The metal has a rather low boiling point under reduced pressure and there is no great trouble in volatilizing it, but the form in which it comes down depends enormously upon the vacuum conditions. In a partial vacuum, at a pressure of about 12 millimeters, Dr. Pettit finds that it invariably deposits in a finely divided form which makes a dead black coating. Many other metals—as different as gold and zinc—do just the same, and the process is useful to *blacken* small pieces of apparatus. At lower pressures—say 1 millimeter—aluminum deposits as a fine white powder. But if the pressure is kept exceedingly low, so that the separate atoms of metal which evaporate from the heated filament fly clear across the vacuum chamber without hitting any gas molecules on the way, they condense on any *clean* surface in the form of a brilliant, lustrous, polished mirror.

One might fear that when air was admitted, this coating would oxidize and be spoiled, but it covers itself with a uniform, transparent, and almost infinitesimally thin film of oxide and suffers no further change. This film is what makes the process valuable. Aluminum oxide is one of the hardest known substances, appearing in nature as corundum (emery) or in its precious forms as ruby or sapphire, and the tenacious coating which automatically forms on the surface has extraordinary protective powers. The film can be washed with soap and water—ordinary soap and water—without damage. Indeed, this suffices to clean off any dust or faint bloom, and no polishing is necessary. Its chemical and mechanical resistance is amazing. A few days ago the writer saw a young physicist take a brilliant aluminum-on-glass mirror and pour concentrated nitric acid over it. A silver mirror would have vanished in the twinkling of an eye, but this one was utterly unaffected and, when washed under the tap and dried with a soft paper handkerchief, was a little brighter than before. Then came a still more amazing test—a strip of sticking plaster was laid on the mirror, rubbed down and pulled off from one end, leaving no trace of injury! These films can, however, be dissolved by caustic alkali solutions, which is convenient for removal of an imperfect attempt.

No one knows yet how long the film will last without tarnish under good conditions—the process has not been invented long enough—but no serious trouble has appeared in a year's service.

The reflecting power for visible light is about 85 percent—slightly less than for new silver but better than silver even slightly tarnished. In the ultra-violet it remains above 80 percent as far as 2500 angstroms. With aluminized mirrors and quartz prisms and lenses, the stellar spectrum between 3400 and 3000 angstroms should now be easily observable.

No one who has seen the new mirrors doubts that the future is theirs. At the Mount Wilson Observatory, for example, all the auxiliary mirrors of the great telescopes—some of them 30 inches in diameter—are being treated by this new process, by co-operation with the California Institute of Technology in whose laboratories a special vacuum apparatus has been developed, capable of taking things up to this size. The troublesome problem of getting the glass surface perfectly clean has been solved and the process is "in production."

THE amateur telescope makers—of whom many, it is hoped, may read this—will naturally inquire: What chance have we at this great improvement? The individual amateur would probably find the process impracticable. The construction of an aluminizing apparatus big enough to hold a good-sized mirror, vacuum-tight up to the requirements of an X-ray tube, and provided with the necessary devices for exhausting the air and volatilizing the aluminum, involves considerable time and cost, and its operation demands a skilled technique acquired only after a good deal of laboratory experience. The average telescope maker can hardly hope to set up so elaborate an outfit, but there seems to be no reason why a co-operative effort might not succeed. Someone with special interest in the problem might tackle it and, if successful, might be in a position to supply his brother astronomers—amateur or even professional—with this new and admirable advantage.—*Mount Wilson Observatory, Nov.* 30, 1933.

Scheduled Atlantic Flying

By REGINALD M. CLEVELAND

How?

When?

LARGE projects, especially those which stimulate the imagination, commonly evoke no little foolish speculation and theorizing in the public prints. This notably has been the case in the discussion of an air line or air lines linking the new world with the old across the Atlantic Ocean. It is pardonable, in view of the rapid flux of aviation development, that guesses concerning equipment to be used for such service have sometimes been wide of the mark. Some of the pronouncements, however, especially some of those emanating from the other side of the big pond, have been little short of ridiculous.

Atlantic air service—leaving out of account for the purposes of this article scheduled service by dirigible, which is already a fact as regards the Southern route, and seems to be peeking happily around the corner as regards the Northern—divides itself into two very distinct spheres. These are the North Atlantic and the South Atlantic. For the purposes of heavier-than-air travel they are in rather strong contrast with each other.

The South Atlantic is an arena for a trade struggle in which European nations, notably France and Germany, are contending with the United States for speed of communication, primarily for the mails, between the great Latin American cities and their home capitals. The advantage seems likely to remain with the United States, for in this case our air-borne mails, passengers, and express, already being carried with splendid efficiency which has reached 99 percent plus of scheduled flights completed, through Pan-American Airways' highly developed system, do not need to cross any major ocean to reach their goals.

Both the French and the Germans, however, are attacking the problem of the South Atlantic project with vigor. The Germans have shown how efficiently the Reich and the Republic of Brazil can be joined by airship service.

GERMANY is now conducting an interesting experiment with heavier-than-air transport, sending mails down the West African coast to Bathhurst in British Gambia, and thence, in Dornier Wal flying boats, across the stretch of sea amounting to nearly 1900 miles between the African and Brazilian coasts, in two hops. The flight is broken near mid-ocean by the use of a mother ship which serves at once as receiving and sending air field; the converted steamer *Westfalen* cruises about a limited area and gives the on-coming plane her location by radio. As the flying boat approaches, the *Westfalen* proceeds under slow way in the same direction as the plane's flight, creating with a drag sail a "slick" in her wake. The plane lands in this smooth area, and the vessel, gathering speed, draws the sail up closer to the surface of the water, so that in effect it becomes a slightly submerged ramp. The plane taxies thereon and is lifted over the stern by booms. Then the same plane can either be serviced and refueled, and catapulted from the deck for the second stage of the journey, or the load can be transferred to a second waiting plane as desired.

The French seem committed to the single hop method, and have made test flights between Dakar in Senegal and Natal, Brazil, with flying boats carrying mail. Several French designers have produced long-range load-carrying boats which are intended for this service. Should they prove successful, they will substitute wings for the fast dispatch boats or "avisos" which have heretofore been used to carry across the stretch of sea the mails which are flown from France to her African colony and again flown from the easternmost point of Brazil down the coast to Rio and Buenos Aires.

The North Atlantic presents a different problem, and it is about this problem which most of the unjustifiable speculation has centered.

In the first place, in the nature of things, service by airplane across the North Atlantic must be a co-operative and international undertaking, rather

An artist's drawing of an Armstrong seadrome being towed to its anchorage site

than a strictly competitive one. Harbors which must be used by flying boats, whatever route or routes be selected, are under the sovereignty of different nations. For example, the ports of the United States coast are under our own jurisdiction; Bermuda and the Canadian outposts are under that of the British Empire; Greenland and Iceland where concessions have already been granted to Pan-American Airways—owe Danish allegiance; and the French have long-term concessions in the Azores which, even should they be abandoned, as has lately been rumored, would revert to Portugal.

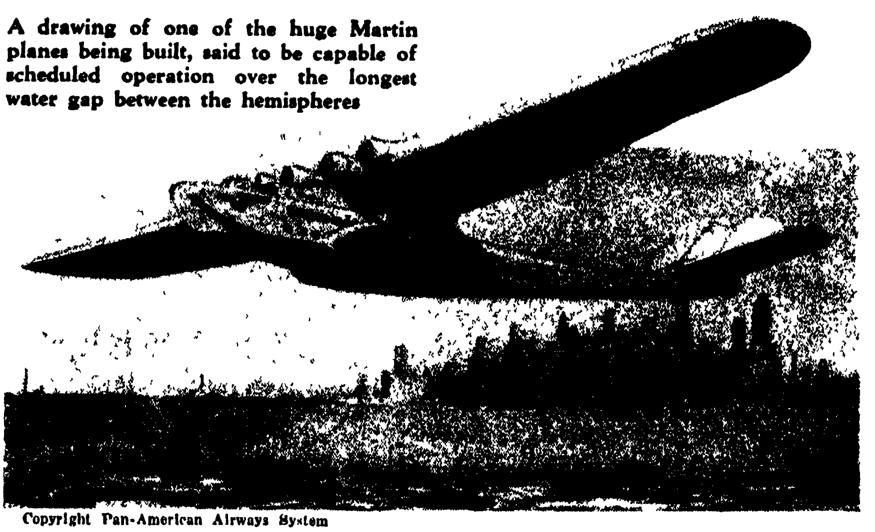
The British, the Germans, and the Danes, as well as American interests, have conducted and in some cases still are conducting, careful surveys, both geographical and aerological, of the route by way of the northern islands. Portions of this route have also been surveyed from the air during recent months by Col. Charles A. Lindbergh and his wife, the Colonel flying in his capacity as technical adviser of Pan-American.

It is obvious that the North Atlantic field is still a subject for study and survey. Those who profess to say that a specific route of scheduled airplane service will be flown at a specific date are drawing on imagination rather than fact. Nevertheless, there can be no real doubt that such a service will be instituted, and little question that Imperial Airways, Air France, and Pan-American Airways, with the last named the operating unit, will all play parts in the perfected drama.

It has been announced by the Secretary of Commerce that 1,500,000 dollars will be appropriated from the recovery funds by the Government for the construction of a quarter-section of one of the seadrome landing fields long advocated by Edward R. Armstrong. The implication that, should this section prove its case, the Government would construct a chain of five such seadromes across the North Atlantic at a cost of about 30,000,000 dollars, has injected another element of intense interest into the Atlantic airline question.

Basically, the seadrome is a landing platform 1200 feet long and 350 feet wide, supported by streamlined, telescopic columns which extend far below the surface of the sea. Utilizing the known fact that below a comparatively trivial depth there is no wave motion in the ocean, no matter how tumultuous the surface billows, Mr. Armstrong has placed his ballasting chambers deep in this zone of perpetual calm. At the same time he has raised the platform out of the water far above the highest recorded wave level. By reason of both these factors, and the open character of the columnar supports of the platform, it remains level and unmoved in calm and storm.

A drawing of one of the huge Martin planes being built, said to be capable of scheduled operation over the longest water gap between the hemispheres



Copyright Pan-American Airways System

Critics of the seadrome plan—and they have been not a few, including fliers of as much experience as Clarence D. Chamberlin—allege:

That before a chain of seadromes could be constructed, flying boats will be in the air capable of making the North Atlantic crossing by way of Bermuda and the Azores, for example, with pay loads.

That, while from an engineering standpoint, the landing fields may well do what their designer contends they will do, their maintenance cost would prove prohibitively high.

That they necessitate the use of land planes over stretches of water 500 or 600 miles long, or of amphibians which, in large sizes, are too heavy to be economically practical.

That, if it is desired to break the Atlantic stretch into shorter segments than those provided by natural islands on either northern or southern route, mother ships of the *Westfalen* order could provide such intermediate points at a fraction of the cost.

The advocates of the seadrome idea contend, however:

That even when planes of sufficient range for the Atlantic journey, say by way of Bermuda and the Azores, are flying, their pay load could be multiplied by four by refueling them in the air or at sea from the seadrome bases.

That reliability of airplane performance has reached the point where 500 mile stretches are not to be considered hazardous, and that even if land planes were to be used over such stretches, they could be provided with flotation gear, as are carrier fighting craft, so that, in emergency, swift power cruisers based at the seadrome could rapidly effect rescue of crew and cargo.

That such a chain through the medium of tolls, would be a swiftly self-liquidating investment, and of as great importance to the nation as the Panama Canal.

That the steady, ample landing fields, provided with every sort of comfort, from hotel to swimming pool, would serve as the surest haven which could be provided for aircraft, having fixed position and dependable stability, regardless of weather.

Whether or not a seadrome chain, with its many intriguing possibilities, is forged to join us by a series of giant links with the Old World, there can be no question that heavier-than-air equipment, fit to make the journey, will soon be in the air.

The first of the giant flying boats under order for Pan-American may have emerged from the Sikorsky plant at Bridgeport ere this issue reaches its readers. It will have a range of 2500 miles against a 30-mile head wind, with a mail load of at least 500 pounds. It will have a 1200-mile range, with 32 passengers, and at least a 600-mile range with 50 passengers. These specifications apply also to its two sister ships under order. The three flying boats for the same line being constructed at Glenn Martin's Baltimore plant will apparently have even larger range and capacity. (See also page 166, March 1933 SCIENTIFIC AMERICAN.)

Conquest of the North Atlantic for scheduled flight does not mean that argosies of airplanes will carry the bulk of tourist travel to Europe this year or next. It does not mean that fast ocean liners must rust at their anchorage. Only those whose zeal outruns their judgment think of it as a threat to the steamship business.

It does mean a magnificent speeding up of that small percentage of the mails which is really urgent—that a vital document can probably be delivered from San Francisco to London by air in 48 hours or less, and that where time is really of the essence of things, statesmen can be whisked from the shadow of the Washington Monument to Downing Street in perhaps two nights and a day.

The dream forged in the splendor of the *Spirit of St. Louis* is coming true.

Photograph by Sidney N Shurcliff

Sundials and Their Construction—I

Planning Simple Equatorial and Horizontal Dials

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M. A.
Research Assistant, Harvard College Observatory

A SUNDIAL shows apparent solar time; but, because of the variation in the length of its days and hours, this is not satisfactory for scientific purposes. Therefore, man has made use of a fictitious "sun," which moves uniformly in the celestial equator. By means of this fictitious sun, mean solar time (watch time) is obtained.

The difference between mean time and apparent time is called the equation of time, which never amounts to more than a quarter of an hour. By using the equation of time a sundial can be constructed which will be an accurate timekeeper, the accuracy depending upon how carefully the hour lines are laid out, the size of the dial, and the division of the hours. It is not impossible to construct a dial that will show the time accurately to the nearest minute.

The hour lines for a sundial may be described upon almost any surface, in any position. Rarely, however, does occasion arise for constructing a dial on any but a plane surface and in either a horizontal, vertical, or reclining position.

There are many different ways of computing the hour lines for each type of dial, all of which are good. The geometric method will be described, because of its simplicity; also because only the most common materials are necessary for the construction of the hour lines by this method, such as pencil, paper, straight-edge, compasses, and protractor.

There are also many ways of laying out the hour lines by the geometric method, but only the simplest and most accurate constructions will be illustrated. For their use no knowledge of mathematics or astronomy is necessary. The accuracy of this method is determined by the care used in drawing the elemental lines. The ease and quickness with which the hour lines may be laid out make it very practical.

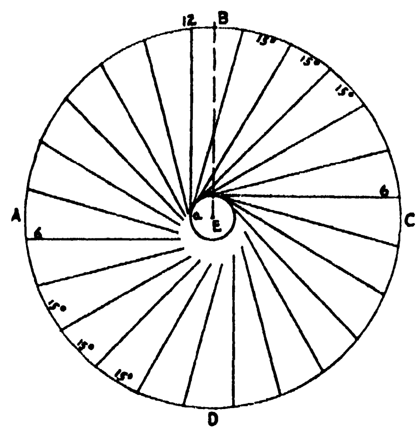


Figure 1

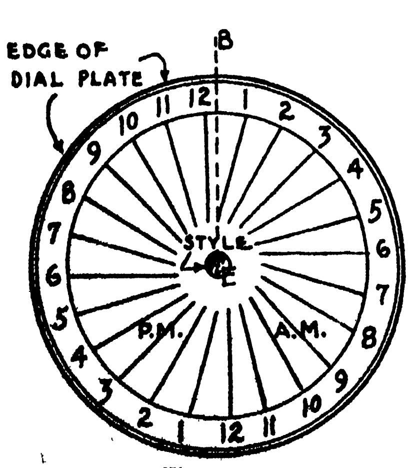


Figure 2

Before the hour lines for a dial can be computed, certain facts must be known. These are: 1—The plane in which the dial will lie. (Horizontal, vertical, or otherwise.) 2—The latitude of the place where the dial is to be used. (The latitude may be obtained from any good map. If greater accuracy is desired use the United States Geological Survey maps.)

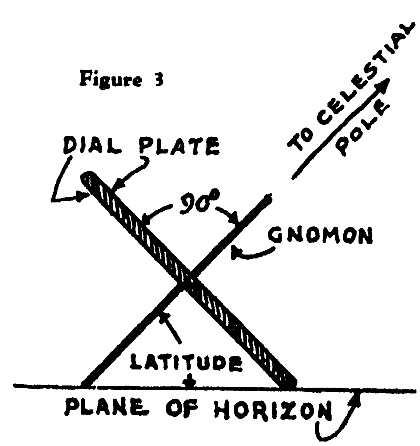
IT is also well to remember that the style should lie parallel to the axis of the earth and point to the celestial pole, and that the style and 12 o'clock line should lie in the plane of the meridian of the place. For those who are not familiar with the names applied to the various parts of a sundial, and as an aid to a proper understanding of the text, the following is a list of parts with a description of each:

Meridian: A great circle of the celestial sphere, passing through its poles and the zenith of a given place. A line on the earth, the plane of which, if produced, would cut the celestial sphere at its pole. This line must be determined before the dial can be placed in position to tell time. A simple and easy method for determining the meridian line at any given place will be described in a later article.

Hour angle: The hour angle of the sun is that angle or arc measured by the time which has elapsed since it was last on the meridian. Since this angle depends upon time, it is usually measured in hours and minutes, instead of degrees. The hour is equal to 1/24 of a circumference, and since there are 360 degrees in a circumference, one hour is equal to 15 degrees, two hours equal 30 degrees, and so on.

Hour lines: The lines described on any surface for the purpose of telling time.

Figure 3



Dial plate: The surface upon which the hour lines are described.

Gnomon: Any object which, by its shadow, serves as an indicator.

Style: That edge of the gnomon, elevated above the dial plate, which casts a shadow when the sun shines upon it.

Substyle: The line upon which the style is erected, perpendicular to the plane of the dial. The base of the gnomon.

Height of the style: The angular or

linear distance of the style above the substyle.

Substyle distance: The angle which the substyle makes with the meridian or 12 o'clock line.

Center of dial: In sundials, the point where all the hour lines meet.

Declination of the dial: The angle measured between the meridian passing through the dial, and a plane perpendicular to the plane of the dial. This angle is always measured from the south or north toward the east or west.

THE equatorial dial is the simplest form of the sundial and the easiest to construct. The plane of the dial lies parallel to the plane of the equator and it can be used at any place on the earth, provided the style is inclined at an angle above the horizon equal to the latitude of the place in which it is to be used.

The style is a round rod, which passes through the dial plate and is perpendicular to it, and it should point to the celestial pole. The substyle is at the center of the dial, at the point *E*, Figure 1. The height of the style is determined by the size of the dial plate and is usually made from 6 to 8 inches.

The construction is as follows:

With *E*, Figure 1, as a center, describe a small circle whose diameter is equal to the diameter of the style.

Also, with *E* as a center, describe the circle *ABCD*.

Draw *EB*, for the meridian; then draw the line 12*a*, for the 12 o'clock line, parallel to *EB* and tangent to the small circle representing the diameter of the style.

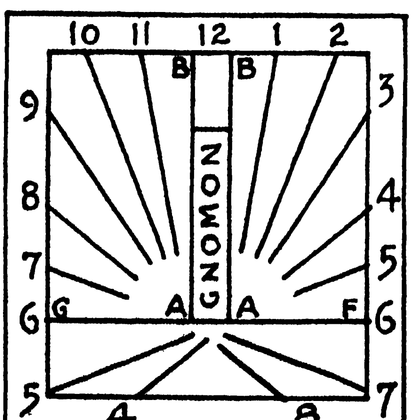
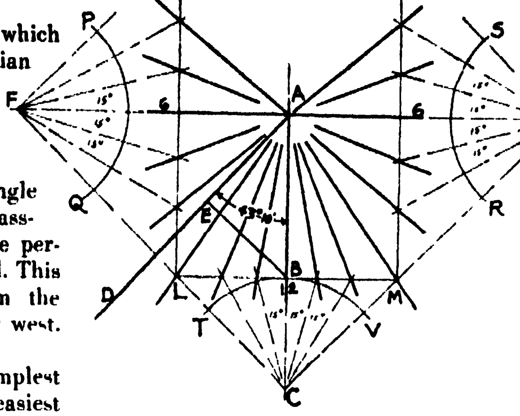


Figure 5

Now divide the circle into 24 equal parts, beginning at the point 12; and from the points thus found draw lines tangent to the small circle and on the same side with 12*a*. These lines will be the required hour lines.

When the style has been erected perpendicular to the dial plate the hour will be shown by the left-hand edge of the shadow. (*Note:* If the style is less

Figure 4



than 1/8 inch in diameter, or if the rod tapers to a point at the top, all the hour lines will be drawn from the center, at *E*; and the division of the hours will begin at the point *B*.)

Figure 2 shows the hour lines transferred to the dial plate, and the method of numbering them, on the upper or north face.

Figure 3 shows the position of the dial when in use.

This dial will show the time from sunrise to sunset throughout the year, if the hour lines are inscribed on both faces of the plate. Otherwise the dial would show only the time during the six months of summer, between the equinoxes.

An equatorial dial must be so placed that the style points to the celestial pole, which will be at an angle above the horizon equal to the latitude of the place. The plane of the dial must be perpendicular to the style, and the 12 o'clock line must lie in the plane of the meridian.

THE horizontal dial is the most common type of dial. Its plane lies parallel to the plane of the horizon. Figure 4 shows the construction of the hour lines for the latitude of 43°10′.

The style points to the celestial pole. The substyle is the 12 o'clock line and lies in the plane of the meridian. The height of the style is equal to the latitude of the place (43°10′ in the instance chosen for an example).

The construction is as follows:

Draw the horizontal line *FAG*, Figure 4. (This will be the 6 o'clock line.)

At *A*, draw *AC* perpendicular to *FAG*. (This will be the 12 o'clock line.)

Draw *AD* so that the angle *DAC* is equal to the latitude of the place. (In this case 43°10′.)

From *B*, on *AC*, draw *BE* perpendicular to *DA*.

Make *BC* equal to *BE;* then make *AG* and *AF* equal to *AC*.

Draw lines *FC* and *CG*. Through *B* draw a line parallel to *FG*, cutting *CG* at *M*, and *FC* at *L*. Through the points *L* and *M* draw the lines *LK* and *MH* parallel to *AC*.

Now, with the radius *BC*, and centers at *C*, *F*, and *G*, draw the arcs *TV*, *PQ*, and *SR*. Divide these arcs into equal parts of 15 degrees each. Draw lines from *F*, *C*, and *G*, through the points thus found, until they cut the lines *KL*, *LM*, and *MH*.

Draw lines from *A* through the points found on *KL*, *LM*, and *MH*. Also draw lines from *A* through the points *L* and *M*. These will be the required hour lines. The hours may be divided into halves, quarters, and so on, by further subdividing the arcs TV, PQ and SR, Figure 4, into the desired number of parts.

Figure 5 shows the hour lines transferred to the dial plate, and the way in which they should be numbered.

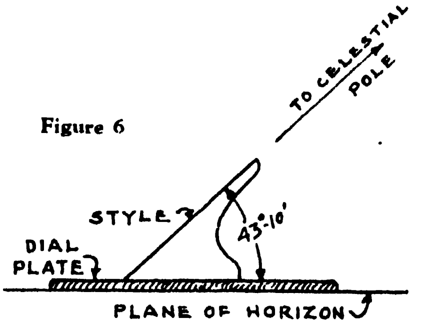
Figure 6 shows the position of the dial when in use.

This dial will show the time, in the latitude for which it is constructed, from sunrise to sunset, throughout the year.

To set the dial, first place it in position and carefully level it. Then orient it, so that the style points to the pole and the 12 o'clock line lies in the plane of the meridian.

(*Note:* When the hour lines are

Figure 6



transferred to the dial plate, allowance *must* be made for the width of the gnomon. In Figure 5 this has been exaggerated. Thus *BB* and *AA* represent the width of the style. Also note that the 7 and 8 hour lines in the evening do not converge in the same point as the afternoon hours, but on the opposite side of the gnomon where the morning hours converge, because they are the prolongation of the same hours in the morning. The same is true of the 4 and 5 hour lines in the morning.)

THE horizontal and equatorial dials are often used as accents or focal points in the garden or on the lawn. They should be placed where there is little or no interference from the surrounding buildings and trees.

●

The next article will describe methods for determining a meridian line, the declination of a plane, and the construction of the south vertical dial.

THE AMATEUR AND HIS MICROSCOPE—VIII

THE DETECTION OF FOOD ADULTERATIONS AND SPOILAGE—II

By K. BERNICE FICK, B. S.
Kroger Food Foundation, Cincinnati, Ohio

(Continued from January)

FINELY ground woody substances added to coffee and spices are more difficult to detect than are starch granules, but by constant examination of the pure and unadulterated product the microscopist can quite readily find and identify such substances as sawdust, ground bark, ground cocoanut hulls, bran, hulls, and weed seeds. Products of this type are examined unstained, either in a water or glycerine mount.

Tea sometimes is treated with a very small quantity of certain coloring materials to give it a bright color or a gloss, in order to make a poor grade of tea appear to be of a higher quality. But if the dust sifted from such a product is examined under a microscope, the solid particles of the coloring material can readily be found. Other leaves are seldom added to tea as an adulterant, but in such a case the foreign leaves are easily detected after the tea has been soaked in hot water for a few minutes to allow the leaves to uncurl, and carefully spread out on a piece of glass, because the true tea leaf is very characteristic in shape and structure, and is easily distinguished from other leaves.

Of course there are some types of food adulterations that cannot be found with a microscope, but must be found by chemical analysis. Although the detection of preservatives and dyes is chiefly accomplished by chemical analysis, some can be found by a careful microscopic examination of the material for certain crystalline and unusual structures which readily can be identified.

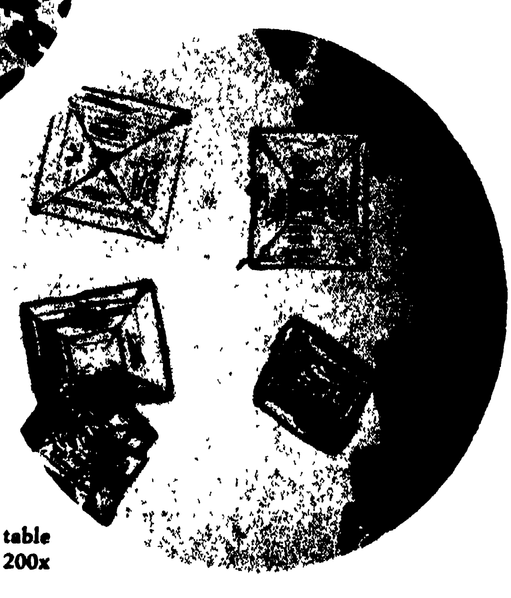
Some crystalline structures are beautiful under the microscope, and here again the amateur microscopist can find numerous crystalline substances right in his own kitchen. Salt, sugar, borax, and Epsom salts are all beautiful under the microscope. The most perfect crystals are obtained by dissolving some of the material in a little water, and allowing a drop of the solution to dry on slides, and then examining the slides without cover glasses under the microscope. This should be adjusted to give about 100 diameters magnification.

The use of artificial dyestuffs in cheaper varieties of jellies, jams, catsups, and sauces gives these products a very desirable color, and tends to mislead the public and to create the wrong idea of the true color of the pure food. Many food colors are harmless and unobjectionable when used in confections and desserts, but when used to cover inferior quality, they are properly considered as adulterants. In detecting some dyes, a microscopic examination reveals small particles of pigments which are not soluble in water, or which have been crystallized out by chemical treatment.

SOMETIMES coloring materials are added to tomato products to cover up the use of sub-standard or unripe fruit. Even though the product appears to be of excellent quality, the microscopist examines it just as carefully as if it were brownish or off-color. He can soon tell whether the manufacturer used wholesome ripe tomatoes, green tomatoes, or tomatoes which were over-ripe and spoiled. He examines the particles of the fruit to determine its degree of maturity, and also searches for the yeasts, molds, and

White pepper adulterated with ground cocoanut hulls (note one showing in center). x200

***Left:* Grains of cane sugar, magnified about 50 times**



← Courtesy Bausch and Lomb →

***At right:* Crystals of common table salt, or sodium chloride, magnified 200x**

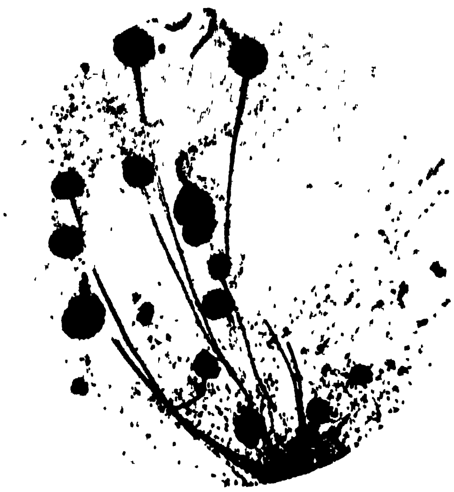
bacteria, which, although killed by sterilization, are present in the product. The number of these organisms reflects the quality of the raw material used; and, by finding the percentage of the fields containing mold, by using a specially designed slide, the microscopist can determine the percentage of spoiled material put into the product when it was manufactured. He can tell, by the type of organisms present, whether the tomatoes were too ripe, improperly trimmed, or whether the equipment used in the preparation of the product was unclean and improperly sterilized.

Although the amateur cannot expect to count the molds in tomato products accurately, he can familiarize himself with the general structure of the tomato and of the various types of molds that he would expect to find in finished tomato products, and in that way prepare himself later to approximate the results of the skilled microscopist.

His first duty is to collect several sound tomatoes, and a few with decayed spots of different types. If the spoiled fruit cannot be found it can be prepared by allowing sound tomatoes to stand at room temperature for several days until a growth of mold is visible.

HE should examine the sound ripe tomato first. By cutting it in half transversely the various parts can be noted—the pericarp or the fleshy wall surrounding the seed cavity, the epicarp or skin, the mesocarp or middle layer of the pericarp, the endocarp or inner layer of the pericarp, the septa or the dividing walls, the seed cavities, and the core. Then, with a pair of forceps or tweezers, a small strip of the epicarp (skin) is stripped off and is floated in a drop or two of water on a clean glass slide, covered with a cover glass, and examined under the microscope, which has been adjusted to give a magnification of 90 to 100 diameters. Very thin sections of the endocarp and mesocarp are examined in the same manner. Small bundles of fibers can be found penetrating these sections, and these particularly should be noted as they very easily might be confused with pieces of mold filiment. The microscopist then should examine a thin cross-section and a thin longitudinal section of the core, and

Cross-section of a common tomato: *a, b, c,* pericarp; *a* being the epicarp, *b* the mesocarp, and *c* the endocarp. *D* is a septum, *e* the core, *f* a seed cavity, and *g* several seeds



***Left:* Aspergillus niger (x100), a type of mold sometimes found on tomatoes. *Right:* Aspergillus clavatus (x100) is a mold causing softening of the pericarp of tomatoes. *Below:* Mucor agariensis from a mushy tomato**

some of the gelatinous substance surrounding the seeds. After this is completed he is ready to examine the decayed tomatoes.

The decayed fruit should be examined just as the sound tomato was examined, the parts compared, and the differences noted.

After the microscopist has thoroughly familiarized himself with the structure of the various parts of both sound and decayed tomatoes, he is ready to study the organisms causing the decay. The most prevalent and most easily recognized types of organisms which cause decay are molds.

Molds vary greatly in color, shape, size, and method of reproduction, but the types most frequently found in tomato products appear as long hairlike threads. Alternaria, the mold which causes "black rot," produces large amber-colored spores which are shaped like Indian clubs with muriform divisions. This is the mold which most frequently causes decay in cracked and sunburned tomatoes.

To examine the mold, a small portion must be teased from the moldy tomato and placed in a drop of oil or glycerine on a clean glass slide, where it is carefully spread out with needles, a cover glass dropped over it, and examined under the microscope, which is still set to give a magnification of 90 to 100 diameters.

Tomato products such as tomato juice, purée, and catsup can be examined, but even to approximate the results of the skilled microscopist, the amateur must supply himself with a specially designed slide and cover glass, and should study thoroughly and follow carefully the procedure as outlined in detail in certain government bulletins which should be available at most public libraries.

Time, special training, and experience are required of the analyst before his results are dependable, but this type of microscopic analysis rapidly is becoming routine procedure in all branches of manufacturing where tomatoes and tomato products are used.

It is unfortunate that we cannot always be certain that our food is absolutely pure, but in recent years food manufacturers have been striving to produce better foods than formerly were produced, and they realize that laboratory control is the best check of quality of raw materials and finished products; also that a skilled microscopist can save much valuable time and materials by his routine examinations. Perhaps it is partially because of his vigilance that the foods we buy today are purer and less frequently adulterated than those which were on the market ten or twenty years ago.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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Motor Cars for 1934

WHAT is probably the most notable advance in motor-car engineering for 1934 is the so-called "Knee-Action" front-wheel suspension used by General Motors. In an attempt to improve riding qualities of cars, many changes in design of front ends have been tried, but always along the same general lines. It has been well known that if the front springs could be "softened," a great improvement would be possible, but any such softening, if carried far enough to achieve the purpose, would result in other troubles with steering and braking. Therefore individual springing of the front wheels was tried and after much development work has been offered to the public.

In the design that has been adopted for Buick, and illustrated in these columns, each front wheel is mounted directly to the frame through two V-shaped arms, one above the other. The arms are hinged at the frame, while the apex of each terminates in a vertical steering knuckle support. Thus both the front axle and the conventional flat springs are eliminated. A coil chassis spring is located between the lower V and the frame. By this construction the spring is relieved of all work except that of carrying the load, and the wheel is left free to move up and down in perfect alignment and without motion in any other direction. With this type of suspension there is considerable spring travel and it was found necessary to help dampen this movement by the installation of rubber bumpers inside the coil springs to take care of compression, and other bumpers on the frame to take care of rebound.

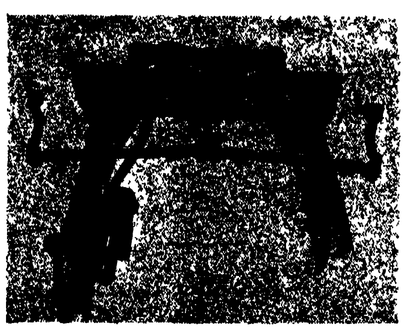
The upper of the two V-arms in the Knee-Action unit is connected directly to the shock absorber mounted on the upper part of the frame. It will be noted from one of the photographs that the whole front end of the car has been redesigned and strengthened to take care of the stresses that were formerly absorbed by the axle.

Steering mechanisms with independently sprung arms had to be completely redesigned in order to take care of the wheel action. A bell-crank mounted in the center of the front frame member is connected through a drag link with the Pitman arm. This bell-crank operates individual tie rods to each front wheel.

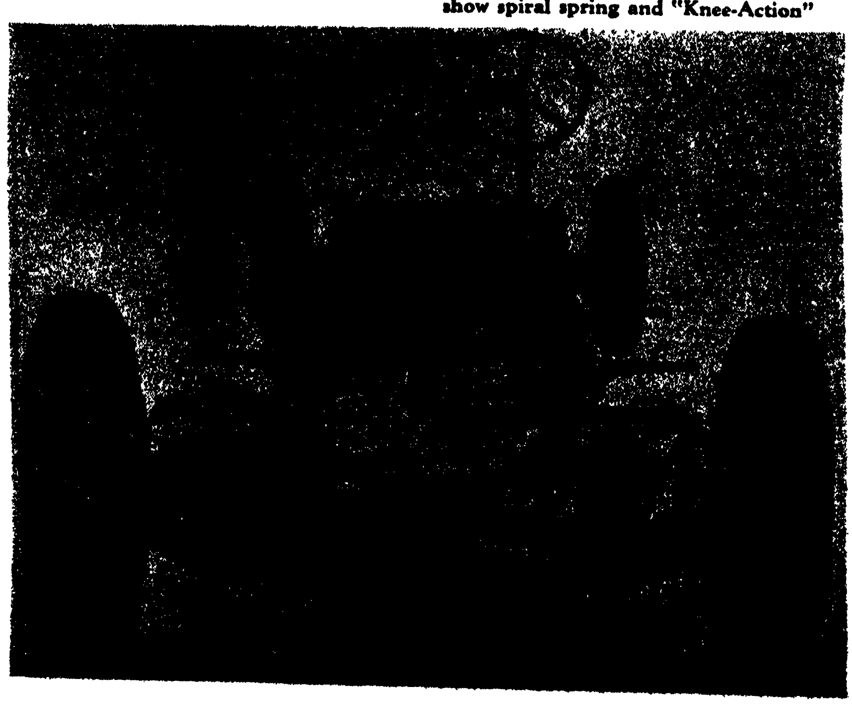
The above description is of the system used on Buick, Cadillac, La Salle, and Oldsmobile; independently sprung front wheels, also doing away with the front axle, but of different mechanical design, are features of Chevrolet and Pontiac.

Another line of cars which will be equipped with independently sprung front wheels is the Hudson. In these cars will be incorporated what is known as the "Axleflex" method of independent spring suspension, to be furnished as optional equipment. While this new method provides something that might be likened to the knee-action described above, it does not dispense with the front axle which is so designed that flexibility is permitted in a vertical plane.

The outstanding body improvement to be incorporated in the 1934 Ford line is a novel ventilating system which permits the use of single plates of glass in each door. When the glass of the door windows is raised in the conventional manner by turning the handle until the top is reached, another half turn of the handle causes the glass to slide backward horizontally, thus creating a vertical opening between the edge of the door or body frame and the glass. This slot serves as a means of exhausting air from the interior of the body. In addition to normal leakage, the entrance of air in small quantities is permitted through holes in the bottom edges of the doors. This air passes upward within the shell of the door and into the body along the window ledges. The small amount of air thus admitted and the surface over which

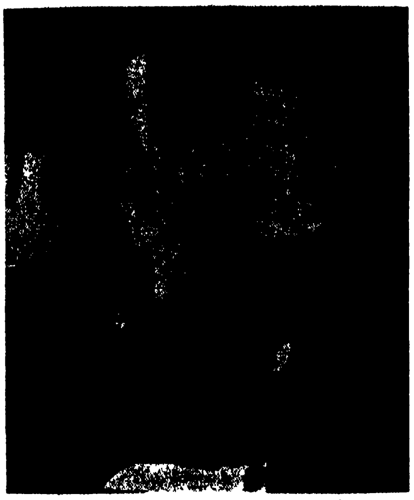


Left: **The new Buick steering linkage and, *below*, Buick frame cut away to show spiral spring and "Knee-Action"**



it is spread in entering prevents drafts yet assures an increasing amount of ventilation as one or more of the window slots is opened. There is also a cowl ventilator.

A departure from standard auto finishing practice is found in the Ford bodies where a new enamel, which is claimed to have unusual wearing qualities, will be used for



Window in new Ford opened from the front edge to permit draft-free ventilation of the interior of the car

both bodies and fenders of all models. The most noticeable mechanical change in the engine is a dual intake manifold combined with a dual down-draft carbureter. The manifold is combined with the valve chamber cover. The standard Ford models will be equipped with fuel pumps but a limited number of cars will be supplied with a self-feeding carbureter used in conjunction with the present type of single manifold.

Engineers of the Lincoln Motor Company have decided to concentrate upon the production of a single 150 horsepower, 12-cylinder, V-type engine and this will be the only Lincoln power plant available in 1934. It will, however, be mounted on either a 136-inch wheelbase or a 145-inch wheelbase chassis according to the desires of the purchaser. The Lincoln bodies will be equipped with a ventilating system similar to that used in the Ford and described above. New equal-action brakes with cable conduit control and a vacuum brake booster will provide ample braking for even emergency stops with but little pedal pressure. The maximum compression pressure in the Lincoln engine is 132 pounds per square inch but new aluminum cylinder heads are said to permit the use of this high compression without requiring premium fuels. The pistons used in this engine are plated with aluminum oxide which provides an unusually hard surface. (It will be interesting to note in this connection the first paragraph in the center column of page 81 of this issue wherein is described the use of aluminum oxide on telescope mirrors.)

Individual draft-proof ventilating systems were first introduced by Stutz in 1926 and have been available ever since. It is again offered as optional equipment on the 1934 Safety Stutz models. Stutz also offers thermostatically controlled hood doors which eliminate the necessity of the driver opening and closing the doors to conform to weather conditions and engine temperatures. The doors on each side of the hood are controlled independently of the doors on the other side.

De Soto is this year offering the nearest approach to the streamlined motor car that has yet been available in production lines. The reader is here referred to the article entitled "Streamlining and Your Automobile" and particularly to Figure 10 on page 79 of this issue, wherein is shown the general design of a streamlined car similar to that now offered by De Soto. Another feature of the De Soto is that the body and chassis are built in one unit using principles of cross-bracing that have been proved highly successful in bridge construction. Thus the body can be made more rigid and there will be less likelihood of squeaks and rattles over a long period of time.

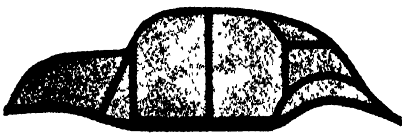


Diagram of the combined body and chassis construction of the De Soto

Physiological Effects of Alcoholic Drinks

"AFTER the first glass of champagne we notice the conversation, instead of being spasmodic and forced, becomes general and free. . . . Each man thus not only reveals himself more to his fellows but is more ready to appreciate the merits and conversation of those around him. In a word, the use of alcohol in moderation promotes good fellowship. With this greater freedom of interchange of ideas there is less restraint of gesture; facial expressions become more animated; ideas in every man seem to flow more freely and speech becomes more ready.

". . . But when the party breaks up and its members enter their various automobiles for the trip home, have their psychological reactions and their muscular coordinations been so dangerously affected that, as motorists, they are to some degree menaces to public safety? Or if it is a mid-day meal and they have an afternoon of work in office, shop, or factory before them, have their physical and mental efficiencies been impaired by this convivial feast? . . .

"The basis of discussion of this question (liquor) should be shifted . . . to the sounder basis of the control of the sale of alcohol as a narcotic drug. However, the use of alcoholic liquors by a large proportion of the population is a striking testimonial to its contribution to the pleasures of life and to conviviality. The solution of the question of liquor control should possibly be a compromise between these opposing arguments."

The above comments, taken almost at random from a three-page article with graphs published by us in our October, 1930, issue, were selected to indicate the availability of a sane and authoritative discussion on this very timely subject. Since a number of people have asked us for an article of this nature, we wish to point out that we covered this subject sufficiently far ahead of repeal to give the opposing forces information to help them carry on their fight. We have recently received several requests that we publish an article of this nature; instead, we have planned to make a separate reprint of this discussion in its entirety for any who may desire it. We will be glad to mail these three-page reprints to our readers for 25 cents each, or will be glad to make a special low quotation on large quantities.

Too Much Medicine

MEDICINE droppers with flared tips are not sufficiently accurate to use in measuring a dose of medicine prescribed in drops, it appears from studies by Professor William J. Husa and Lydia J. Husa of the University of Florida. In their report to the American Pharmaceutical Association they mention the case of a child who showed symptoms of overdosage with belladonna as a result of the use of this type of dropper for measuring the dose.

Droppers with flared tips are commonly used for dropping liquids into the eye, the flared tip serving to protect the eye from injury. When used for medicine to be taken internally, the Florida scientists recommend that the dispensing pharmacist check the size of the drops from the dropper before giving it to the patient. The drops from such droppers were found to be from 35 to 60 percent larger than the standard size drop recommended by the International Pharmaceutical Conference at Brussels.—*Science Service.*

Research Makes Little Failure A Big Success

MEN have been recognized and honored for their contributions to science, but it was not until December 8, 1933 that a company was singled out for recognition of group effort and attainment in chemical engineering. The Carbide and Carbon Chemicals Corporation was the company so honored, and the award was made by a distinguished committee of chemical engineers in behalf of the technical journal, *Chemical and Metallurgical Engineering.* This honor was conferred in recognition of the company's unique feat of creating a great synthetic aliphatic chemical business.

Among the many interesting developments recounted in connection with the award is the story of "Flavorol." According to reports, a number of years ago the research laboratory developed a product that might be substituted for ethyl alcohol in the making of flavors, extracts, essences, and the like. It was christened "Flavorol." It seemed to have all the desirable properties and was an exceedingly good solvent. But marketing was not allowed to begin at once. The management knew this product was to go into many cosmetics, pharmaceuticals, or even

foods. Its physiological properties were investigated by the corporation with the use of thoroughly competent toxicologists and physiological chemists engaged specifically for this purpose. The result must have been something of a shock to the management. The product was so good a solvent that it dissolved material from the stomach and intestinal linings undesirably. No attempt was ever made to market the product for these uses.

"Flavorol" seemed doomed to suffer untimely demise. But a compound with these valuable properties certainly ought to be useful, so the research executives reasoned. They tried it out in new fields, where internal consumption is not contemplated and the degree of toxicity noted is no greater than that of other accepted chemicals. It became necessary to re-christen the child of the laboratories. And under its new name, it is today widely known as "Cellosolve." It is the most potent and widely used of the cellulose nitrate solvents, a necessity for modern plastic making in many of its subdivisions. Research, seemingly unsuccessful, by more research produced a tremendous success.- *A. E. B.*

Photographing a State from the Air

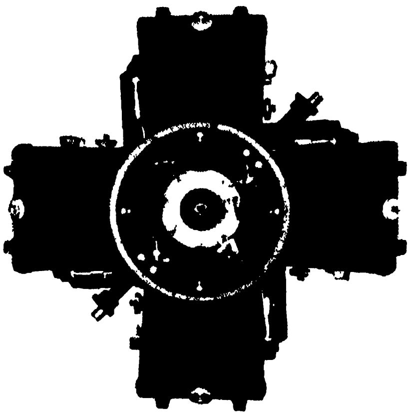
THE Institute of Geographical Exploration at Harvard University performed a wonderful feat in making an air map of Massachusetts, the first state to be completely covered. The area of 8039 square miles was the largest ever surveyed in this fashion. The altitude of the camera was 15,000 feet and the scale of the photographs was 1/30,000 or two inches to the mile. Only 800 composite photographs were taken, with five exposures to each, and the total flying time was limited to 24 hours 40 minutes. This great achievement was made possible by the use of the Fairchild Five-Lens Aerial Camera, the result of many

years development by the Army Air Corps, the Corps of Engineers, and the Fairchild company. This five-lens camera has virtually revolutionized the art of aerial photography.

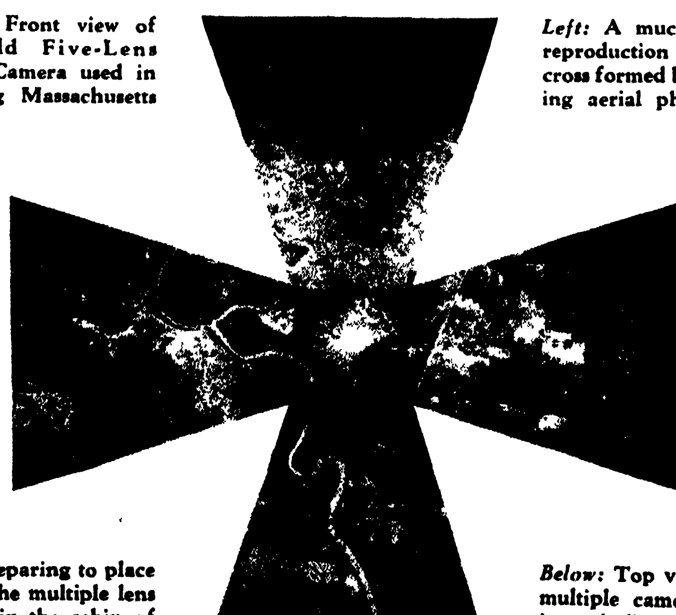
When Lieutenant James F. Phillips of the Corps of Engineers loaded the camera into the Fairchild 71, he was employing a plane standard in every particular, except that the floor had been made thinner in order to avoid interference with the lenses of the camera. The camera hole was located in the rear of the cabin, very close to where the baggage compartment is placed in the regular commercial airplane. By this location, the wheels of the landing gear were almost entirely removed from the field of view of the camera.

The airplane engine was equipped with a powerful blower to maintain power at the high altitude used. Oxygen was supplied to both pilot and photographer to enable them to do their work efficiently. Just behind the pilot a single-lens camera was placed for control purposes, and near each camera hole there was a smaller hole for the vertical view finder. Otherwise no special equipment was called for.

The new camera weighs 104 pounds and is actually five cameras in one. A central lens takes a vertical photograph about five inches square. The four other lenses take oblique photographs simultaneously. The



Above: **Front view of Fairchild Five-Lens Aerial Camera used in mapping Massachusetts**



Left: **A much reduced reproduction of maltese cross formed by combining aerial photographs**

Left: **Preparing to place one of the multiple lens camera in the cabin of the photographer's plane**

five pictures are assembled into one group in the form of a maltese cross. The camera is able to photograph a larger area in less time than any other camera in the world. A single-lens camera would have required many more photographs and about seven times as long a period in mapping the state of Massachusetts. The camera costs about 12,000 dollars, which includes transforming equipment, arc lights, and so on. The five lenses have to be as nearly identical as possible: actually they are ground down to a common focal length with a variation of less than a quarter of a millimeter. All the final settings and adjustments are done under a microscope. The most precise astronomical instruments are not constructed more carefully.

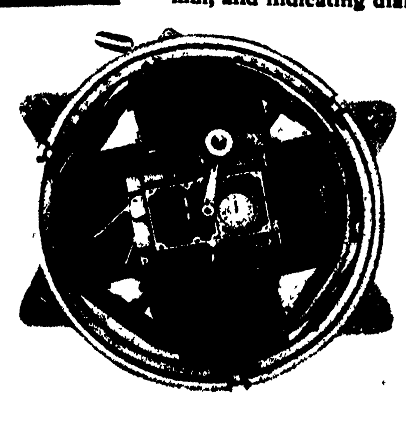
Each of the five cameras or chambers has its own film magazine accommodating sufficient film for approximately 200 exposures, but the films in all five are advanced simultaneously by a single crank. The shutters of all cameras are simultaneously tripped. After the film is developed, the negatives exposed in the central or vertical camera are contact-printed. Those obtained in the four oblique chambers are rectified or "horizontalized" and brought to the same scale as the contact print by means of a rectifying printer.

Experience has shown that the most efficent angular scope is about 70 degrees each side of the vertical, for maximum sharpness of the photographic image, which is adversely affected by the large magnification required and by aerial haze.

The covering power is enormous. With the 140 degree coverage (that is, twice 70 degrees on each side), at 20,000 feet altitude the camera photographs a strip of terrain 20 miles wide. This enormous covering power reduces the photographic flying, the instrumental control, and the laboratory work. When using 60 percent overlap, the centers of seven consecutive photographs in each direction fall on each print. As a matter of fact, overlap is used both forward (60 percent) and laterally (50 percent).

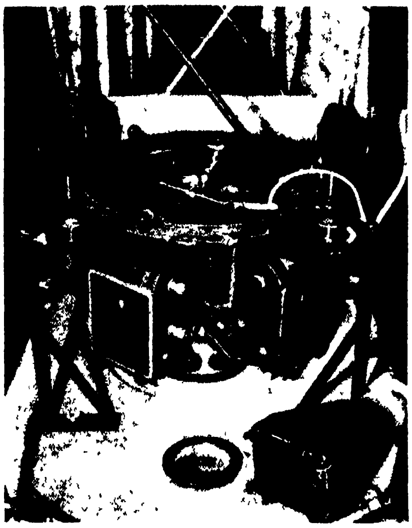
Surveying parties are put into the field and the positions of a number of points which appear on the photographs are ac-

Below: **Top view of the multiple camera, showing winding crank for film, and indicating dial**



curately determined. When these control positions have been obtained and plotted on a master sheet, the photographs are used as plane table sheets as in ordinary ground surveying.

One flight instead of six, and twenty



The five-lens camera installed in the cockpit of a cabin type plane

photographs instead of one hundred is what the five-lens camera achieves.

In the Massachusetts survey, 800 photographs of the maltese cross type were taken. These 800 photographs made a formidable stack eight feet high, for the patient laboratory men to rectify and assemble.—*A. K.*

Australia's Air Trophy

THREE thousand dollars' worth of 18 carat Australian gold has gone to the fashioning of a cup to be presented to the winner of the 75,000-dollar air race from London to Melbourne in connection with the Centenary celebrations this year.

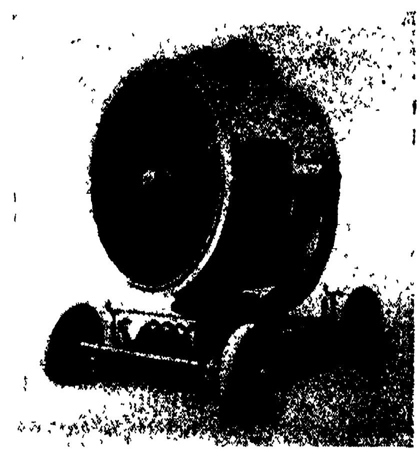
The cup which, with the prize money, has been given by Sir MacPherson Robertson, the Australian millionaire confectionery manufacturer, has just been finished. It is the largest gold cup ever made in Australia. It stands 22 inches high and is in the form of a two-handled vase of classical design. On opposite sides are two solid gold spheres, representing the two hemispheres, surmounted by airplanes. Arrangements are being made for its display in London, New York, Paris, Berlin, Vienna, and San Francisco.

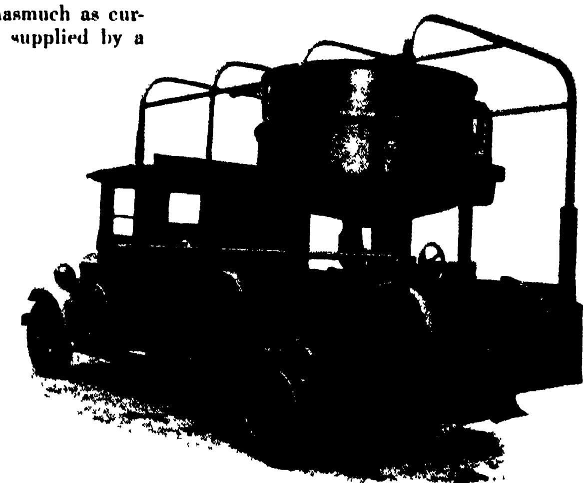
Testing in the Tides

OUR Army Air Corps frequently has to operate in sub-tropical climates; therefore dopes, paints, and protective coatings of their airplanes must be tested for efficiency under sub-tropical weather conditions, as well as moist, salt bearing air. Accordingly, Chapman Field, 15 miles south of Miami, Florida, was selected for a testing station, where wings, bodies, and so on are mounted in exposure racks. Now the severity of the exposure tests has been increased by using "tide-water racks." Wing panels mounted on these racks are subjected to complete immersion at high tide, while at low tides they are exposed to sun and air. These tests will give, in particular, valuable information on the corrosion resisting properties of the metal airplane.—*A. K.*

Anti-Aircraft Searchlights

AN important step in the modernization of the equipment of our Army was taken when the War Department announced the awarding of contracts to the Sperry Gyroscope Company of Brooklyn, New York, for 104 sixty-inch high-intensity anti-aircraft searchlights amounting to 2,015,900 dollars. These are the largest and most powerful searchlights in the world. Sixty-one will be mounted on trailers and 43 will be of the mobile type, which are mounted on a small chassis which can be easily loaded on a truck. These searchlights can be operated anywhere that it is possible to drive a truck, inasmuch as current for the searchlights is supplied by a





Upper right: One of the largest and most powerful anti-aircraft searchlights, mounted on a small chassis. *Right:* The same light ready for transportation on a motor truck. *Below:* 800,000,000 beam candlepower piercing the darkness, from one of the remarkable searchlights described in these columns

generator driven by the power plant of the automotive trucks. The power of each light is 800,000,000 beam candlepower, the results of some 18 years' development carried on by the Sperry Gyroscope Company, in co-operation with Army engineers. The rays of these powerful lights have been seen by fliers at distances exceeding 100 miles.

Remote control makes it possible for the operator to stand several hundred feet from the light and yet maintain perfect control of its operation. Remote control is essential in efficiently operating these lights. The useful range of a searchlight is increased by placing the operator at a point remote from the searchlight, thus eliminating the necessity of peering through the beam.

These new lights are constructed of an aluminum alloy which, due to its light weight, makes it possible to produce 480,000 beam candlepower for each pound of weight compared to only 27,000 candlepower per pound developed in older types of searchlights constructed of sheet metal.

Baby Planes

THE recently appointed Director of Aeronautics in the Department of Commerce, Eugene L. Vidal, is an experienced pilot, well versed in aviation matters. He has caused an immense stir in the aviation world by issuing a questionnaire to licensed pilots, student pilots, and mechanics, inquiring whether such men would purchase a baby or "flivver" airplane of low price and certain special characteristics. In the introduction to the questionnaire Mr. Vidal said: "We cannot hope for a natural, healthy, and widespread growth in the private flying business until we develop a product that will appeal to the man who can afford only a few hundred dollars for an airplane. Volume production and consumption of a popular priced airplane will give the proper impetus to an increase in the number of airports, flying schools, flying clubs, and pilots who will fly only for pleasure."

He defined the characteristics of this plane for private use as follows:

"It is comparatively easy to design and turn out, on a volume production scale, a small airplane which will sell for around 700 dollars. Such a craft would be a two-place, low-wing monoplane, constructed of a new steel alloy, fitted with an 8-cylinder small-bore engine of about 4000 r.p.m. and

a geared propeller. The landing speed would be about 20 miles per hour using air brakes. The plane would be rugged and durable and one that would require very little attention. In fact, it is entirely possible for it to be operated for the full span of its life without major overhauls. Rather than subject the airplane to a major overhaul after several years of service, it probably would be more economical to purchase a new one when that time arrived. Arrangements would be made for selling the plane on a credit basis."

There are about 14,000 licensed pilots, 11,000 student pilots, and 8500 licensed mechanics in the United States, and only about 7000 licensed aircraft. Apparently an opportunity exists to sell say 10,000 planes of this "flivver" type. The proposed construction of 2000 new airports, with loans from the R.F.C., would certainly help this market. That the Chrysler Corporation has engaged Major Seversky to develop his

Eugene L. Vidal, Director of Aeronautics in Department of Commerce

plans for a small ship to sell under 1000 dollars is an encouraging omen.

We thoroughly approve of Mr. Vidal's bold plan, but we see some difficulties in its execution.

It is inconceivable that one manufacturer could capture the entire market. There would be keen competition, and hence a reduced volume for each constructor. This would militate against the theoretically conceivable price of 700 dollars.

To secure a landing speed of 20 miles per hour, even with the use of flaps, is extremely difficult. The loading per square foot of wing area has to be so light that the plane becomes one of comparatively large dimensions, and the top speed becomes low. Moreover, a plane with very light loading behaves badly in gusty weather. It partakes more of the character of a fair weather plane, suitable only for airdrome flying or very short cross-country hops.

Alloy steel, of high strength characteristics, is difficult to employ in small planes. The sections small enough to make use of their theoretical strength are too small for practical construction.

If the plane is to be rugged enough to avoid overhauls, its structural weight will be high. This militates against the light loading necessary to give the 20 miles an hour landing speed.

There is no engine of the desired characteristics yet available.

It is not an easy task to design such a plane. It is a task which will test the ingenuity of the designer to the utmost, and one which may require years for its solution. Attempt after attempt to meet a similar specification has ended in only indifferent success.

But if we differ with Mr. Vidal on the technical aspects, we think he is absolutely right in stating the problem, in stimulating thought, and in setting hundreds of eager minds to work in its solution.—*A. K.*

A "Flying Fortress," carrying five machine guns and a bomb

Gasoline More Powerful Than TNT

GASOLINE is an explosive ten times more powerful than TNT, Dr. George Granger Brown, professor of chemical engineering at the University of Michigan, declared in an address on "Combustion of Hydrocarbons" before the Chicago Section of the American Chemical Society.

"We cannot put TNT steadily to work because we do not know how to control its explosion," Dr. Brown said. "No one would think of trying to run an engine on TNT or dynamite because the violence of the explosions would tear the engine to pieces. A gallon of gasoline exploded under the same conditions could do ten times the damage of these high explosives. However, it works harmlessly and usefully because we know how to control and harness its explosive power."

A Flying Fortress

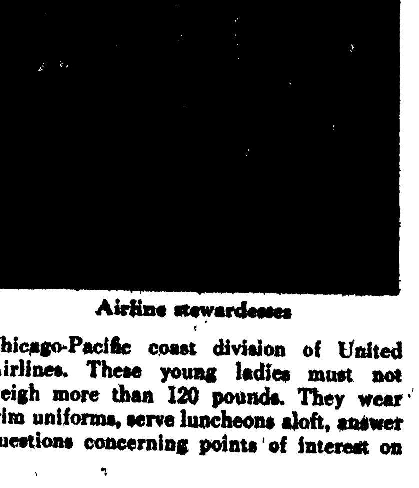
THE Curtiss Aeroplane & Motor Corporation is building 46 two-seater A-12 attack monoplanes for the Army Air Corps, powered with the Wright 700 horsepower Cyclone engine. The A-12 is often referred to as a "Flying Fortress" because it carries five machine guns and a bomb under the fuselage. It is built entirely of metal, including the covering of wings and fuselage. Slots at the leading edge and flaps at the rear edge reduce the landing speed. Pilot and gunner are seated in enclosed cockpits, provided with ample windows. Ships fly far too fast to-day for the open cockpit to be really efficient even for fighting planes.

Bracing wires on the A-12 run out from the fuselage to the upper side of the wing, and to the under side of the wing from the landing gear. The principle of internal bracing is sacrificed, but the structural weight is considerably reduced thereby.

A two-seater attack plane of this type is a terrible menace to soldiers on the march. —*A. K.*

Flying Stewardesses

THE attractive young ladies in the photograph are grouped in front of a Boeing transport of the type used on the



Airline stewardesses

Chicago-Pacific coast division of United Airlines. These young ladies must not weigh more than 120 pounds. They wear trim uniforms, serve luncheons aloft, answer questions concerning points of interest on

Two of the new feathering-blade ship drives installed on the *Kempten*

the airway, provide reading and writing material, see that passengers are comfortably seated in their reclining chairs, and above all maintain the morale of passengers when this sinks low under the influence of strange surroundings!—*A. K.*

Nose Is Gateway Of Invasion

EXPOSED endings of the nerves of smell, in the delicate membranes lining the nose, are the gateway by which the virus of poliomyelitis (infantile paralysis) may enter the system. The nerve trunks to the brain, nerve connections in it, and nerves returning to the body surface are the paths the invasion follows. So long as it stays with nerve tissue, the disease virus is to a large degree isolated from the blood and lymph, so that protective substances formed in the body or introduced into it cannot reach it effectually, and it is free to continue its malignant work.

This, in brief summary, is the story of poliomyelitis invasion, as studied by Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, New York City, and reported before the National Academy of Sciences.—*Science Service.*

(The statements made above have further bearing on the fact, well-known to physicians, that cases of poliomyelitis have been caused by the dangerous practice of pulling hairs from the nostrils, thus opening a path for infection with the virus. -*Editor.*)

Winter in Summer

SHOOTING high into the air from an oil well, carbon dioxide fell in the form of snow and suddenly transformed a torrid bathing beach into a winter scene, according to the Poland correspondent of *Industrial and Engineering Chemistry.* This unique behavior of the gas used to make "soda pop" and "dry ice" occurred at the resort of Krynica in August.

New Ship Drive Uses Feathering Blades

DURING the last few years a series of practical tests has been conducted with a new type of ship drive using a non-reversible constant-speed prime mover which not only gives extreme maneuverability under all conditions but also dispenses with the conventional rudder. Essentially this ship drive unit consists of a series of four or six blades mounted on a disk which is set near the stern of the ship and flush with the hull. The blades arranged near the circumference of the disk or rotor are placed perpendicularly to the hull and are thus completely submerged at all times. The propeller blades have axes substantially parallel to the vertical propeller axis and while rotating around the latter in a circular path feather about their own axes in such a manner that they

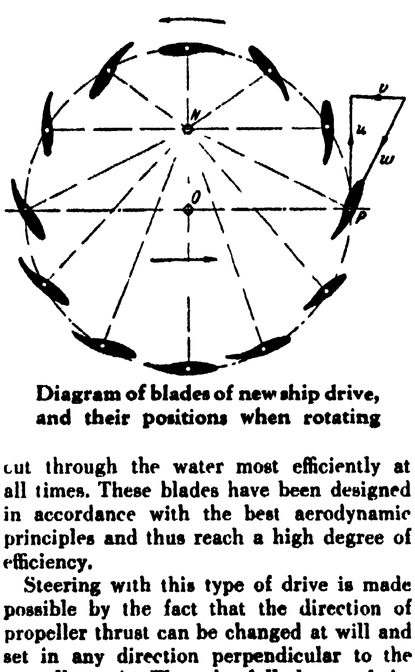


Diagram of blades of new ship drive, and their positions when rotating

cut through the water most efficiently at all times. These blades have been designed in accordance with the best aerodynamic principles and thus reach a high degree of efficiency.

Steering with this type of drive is made possible by the fact that the direction of propeller thrust can be changed at will and set in any direction perpendicular to the propeller axis. Thus the full thrust of the propeller is available for maneuvering purposes in any direction. Propulsion and its control are effected by varying the pitch of the propeller, or, in other words, the magnitude of the thrust, which can be adjusted to all values between full speed ahead and full speed astern, while the direction of rotation and speed of both the propeller and its driving mechanism remain constant.

With small propellers the angle of the blades is controlled mechanically whereas in larger installations the blades are operated hydraulically.

At the propeller controls, which are operated by one man independently of the engineer, there is a wheel which is rotated to change the direction of thrust of the propeller and thereby maneuver the ship, and a speed lever which controls the feathering movement of the blades in such a way that the vessel travels faster or slower while the speed of the propeller remains constant. This Voith-Schneider drive, as it is called, has been installed on several different vessels ranging in size from 43 feet to 150 feet in length with capacities of 50 to 410 horsepower per propeller. It has been determined that the drive will operate satisfactorily over long periods of time with little or no mechanical trouble and that since the entire operation of the ship is under the direction of one man, a forward step has been made in safety and efficiency in navigation.

Close-up of a four-bladed rotor of the ship drive described herewith

Purity Increases Usefulness of Iron

IRON is such a common metal that we think we know all about it. Yet new processes have made available at commercial prices an iron so pure that it is hailed as a "new metal." Analyzing 99.92 percent iron, this metal exhibits properties that open an entirely new field of usefulness for iron, says *Chemical and Metallurgical Engineering.*

As a chemical raw material, the metal is desirable because of freedom from impurities, high content of metallic iron, and lack of iron oxides. In general, this new iron enters into the manufacture of two types of products: organic iron compounds used in the pharmaceutical trade, and iron salts and oxides used in the textile industry and as pigments. Among these, ferric nitrate is used in silk dyeing and weighting and for coloring buff on cotton. Ferric chloride is used as a mordant. Ferrous sulfate (copperas) is used as a mordant and in making ink, Prussian blue, and red oxide. Ferrous acetate is used as a mordant in leather dyeing and calico printing. Ferric hydroxide, called iron buff or Nankin yellow, is used as a dye. The pigments made from oxide are based on the use of pure ferric oxide, F_2O_3, and include red ochre, rouge, and venetian red. The iron is also used in the manufacture of Van Dyke brown and tannate of iron black.

The utility of the metal as a material of construction for process equipment rests upon its unique physical properties and its resistance to corrosion as compared with other ferrous metals. It has a high melting point, 1535 deg., Centigrade, which makes it suitable for heating equipment except that exposed to direct flame and uncooled,

as in roasting furnaces. It also has the ability to withstand alternate heating and cooling almost indefinitely without fatigue, change in structure, or distortion.

The metal, being the softest form of iron ever produced, has been found useful for parts of equipment such as gaskets, shims and spacers, where it is necessary to have a constant thickness over long periods of use. For instance, it may be used for boiler heads, and similar applications where the repeated heating to which it is subjected does not change its thickness.

Another useful characteristic is that the metal will not form an amalgam with mercury under ordinary conditions. This makes it suitable for equipment used in the handling of mercury, as it is naturally less fragile than much of the material that has been used for this purpose.—*A. E. B.*

New Joist-and-Plywood Floor Panel

A NEW type of floor panel built on a principle borrowed from airplane design is demonstrating high strength and efficiency in tests at the United States Forest Products Laboratory. Among the possibilities indicated are a substantial increase in speed of floor construction, a considerable saving of materials, and a distinct gain of head room in each story by the use of the new units, in which plywood sheets are glued to the top and bottom of several joists.

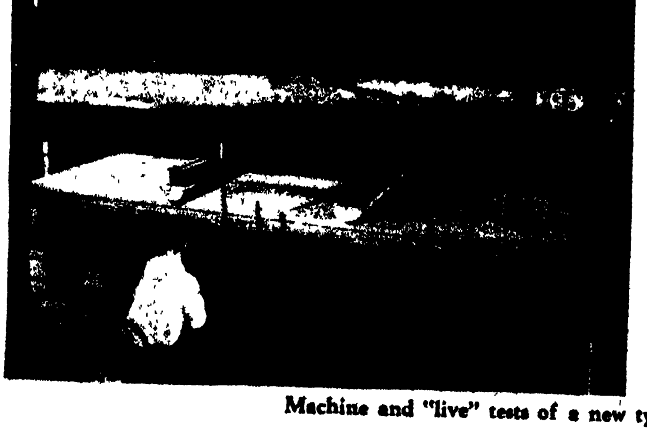
The new panel is regarded as a definite contribution to the ideal of modern wood housing of unit construction. The top plywood, which is relatively thick, serves as a subfloor, and the thinner bottom plywood forms the ceiling for the room below. By virtue of its being glued to the joists, the plywood helps to resist the bending stress, forming what is now called in airplane construction a "stressed covering"—that is, a shell which not only distributes but to a large extent relieves the load on the framework which supports it. In the present experiments it has been determined that, for spans common in house construction, the required strength and stiffness can be obtained with 6-inch joists instead of the usual 10-inch joists—a net saving of 4 inches in the thickness of the floor system.

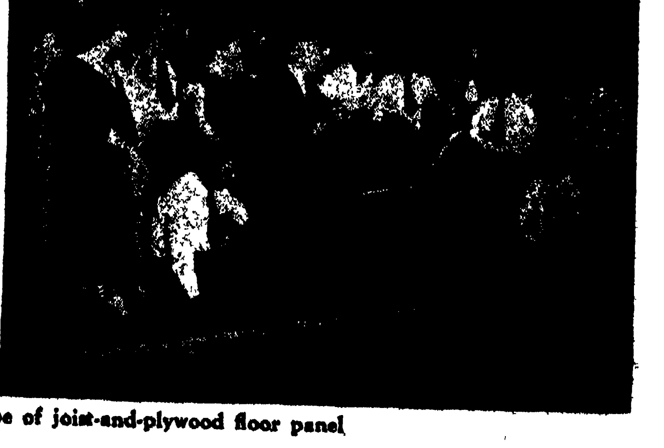
Of the panel types tested, that which appears to offer the best possibilities, in the opinion of George W. Trayer, engineer in charge of the investigation, is one having a width of four feet, with a nominal two by six inch joist on either side and one of the same size running down the middle, the side joists being grooved at midheight to receive a spline connector, top covering five plies thick, and bottom covering three plies.

One of the photographs illustrates a "practical" loading of two two-foot panels laid together over a span of 13½ feet. In this width, the joist down either side of the panel was resawed to half thickness, and one joist of full nominal thickness occupied the middle. The "live" load as shown, minus the piano, weighed 2806 pounds, representing 100 pounds in excess of the residential floor load of 50 pounds per square foot commonly allowed in building codes.

Under this excess loading, the deflection of the panels at the middle was only 0.26 inch, whereas 0.45 inch deflection was allowable under the ordinary rule of 1/360 of the span.

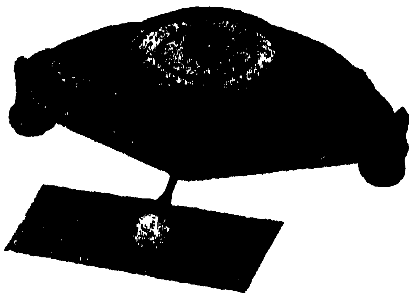
It is said that the joists have less to do with the strength of this kind of floor than one might think at first glance. As a direct result of gluing instead of nailing, a series of box girders is formed, in which the main tensile and compressive stresses are thrown into the plywood "flanges." The joists serve excellently as web and spacing members. The net result is that the three-joist four-foot unit shown in the machine test picture turned out as effective for all practical purposes as the two in the group picture. At an equivalent load and figured for the average run of commercial material, it gave only 10 percent more deflection, and a full 15 percent less than the common building code allowance.





Machine and "live" tests of a new type of joist-and-plywood floor panel

Golf At Home



A device for golf practice at home; it is both substantial and accurate

A SUBSTANTIAL well-built indoor golf playing set-up is now available for those inveterate golfers who cannot stand the rigors of winter without some substitute for their summer days on the links. This set-up, known as Powell Golf, requires only enough space to accommodate the swing of the golf club, is self-contained, needs no net and no attention, and has nothing to get out of order. The player swings at the ball with all the power that he would put into a normal drive or approach shot. The weight of the unit is such that no amount of force applied to the tethered ball can move it from the floor, yet it does not need to be fastened down.

On the top of the unit are two dials which show the distance of drive and the hole being played. An entire game of 9 or 18 holes can be worked out and played straight through without moving from the device. After the distance pointer is set, it registers the length of the drive, the approach shots, and the putts, thus showing incidentally how many strokes are required to "make" a given hole.

Phosphorescent Pigments

NEW methods of producing phosphorescent pigments are described in a recent issue of *Solvent News*. These formulas are said to have an advantage over conventional types of phosphorescent pigments in that they do not include any zinc sulfide. The following formulas are given:

Greenish-blue phosphorescence: A mixture of 20.7 gms. strontium hydrate, 8.0 gms. sulfur, 1.0 gms. lithium sulfate, and 6 cc. of 0.3 percent aqueous colloidal bismuth is heated in a porcelain crucible for 40 minutes to a point of incandescence. The mass is then allowed to cool slowly.

Red Phosphorescence: 40.0 gms. barium oxide, 9.0 gms. sulfur, 0.7 gm. lithium phosphate, 3.5 cc. of 0.4 percent alcoholic copper nitrate. If the lithium phosphate cannot be obtained, it may be replaced by a mixture of magnesium phosphate and sulfate or carbonate of lithium.

Red Phosphorescence: 40.0 gms. magnesium phosphate, 0.7-1.0 gm. lithium sulfate, and 3.5 cc. of 0.4 percent alcoholic copper nitrate.—*A. E. B.*

New Antidote For Mercury Bichloride

AN antidote for poisonous bichloride of mercury (corrosive sublimate) has been discovered by Dr. S. M. Rosenthal of the United States National Institute of Health at Washington. It has already been used successfully to treat a victim of bi-

chloride of mercury poisoning. Cautious government scientists point out that the antidote is still in the experimental stage. However, results with animals poisoned by bichloride have been very good and the successful result with the first human case is considered very encouraging.

The new antidote, said to be the first known for bichloride of mercury, is formaldehyde-sulfoxylate. It is given to the victim by mouth and injected into his veins simultaneously.

This type of poisoning is not very common, so that it may be some time before physicians have enough experience with the new antidote to determine its value.—*Science Service.*

Chemical "Flower Gardens"

THIS column frequently receives requests from readers who wish to "grow" a "chemical garden." To produce this interesting phenomenon it is only necessary to prepare a glass jar by filling it with concentrated solution of sodium silicate. To start a "growth," drop into the solution a small crystal of some metallic salt, such as ferric chloride, cobalt nitrate, or nickel chloride.

The explanation of the plant-like growth is given by *Silicate P's and Q's* as follows: "The crystal begins to dissolve and as it does so reacts with the silicate to form a gel-like surface film. Water from the silicate solution diffuses through the permeable membrane and dissolves more salt. The osmotic pressure causes the cell walls to swell, then burst, and sends long tendrils upward. Without apparent reason the growth stops suddenly, a new sac develops at the tip, swells, bursts, and new tendrils thrust themselves upward with surprising rapidity. It is a fascinating phenomenon." —*A. E. B.*

A Versatile Fire Alarm

AN electrically operated fire alarm unit which may be screwed into any lamp socket of a 110-volt 60-cycle alternating current line has recently appeared on the market. Within the unit is an accurate thermostat arrangement and an intermittent howler which, when operated, gives an unmistakable signal.

The thermostat part of the alarm is actually in two sections so as to insure positive operation under all circumstances. It is claimed that a sustained rise in temperature of from 15 to 20 degrees, Fahrenheit, per minute, for one or two minutes, in the room in which a Vitalarm signal is installed, will immediately be detected and the alarm sounded automatically. This will occur regardless of the room temperature at the start of the fire—whether it be 10 degrees below zero or 100 degrees above, a sudden or unnatural rise of temperature will immediately operate the alarm. The adjustment of the unit has been so carefully worked out that ordinary changes in room temperature will not cause false alarms but care must be taken that the unit is not placed too close to a radiator, stove, furnace, or other source of heat, or that it is not placed where the rays of the sun may fall directly upon it.

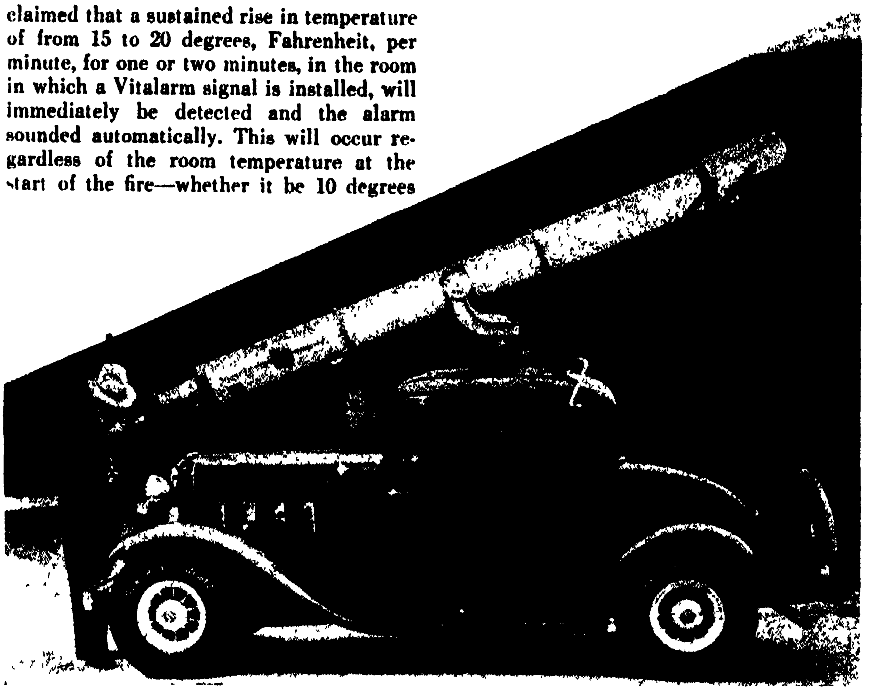
A small neon lamp is a part of the unit and indicates at all times that the signal is in operating condition.

These alarms are suitable for installation in any part of a home or in storage rooms, garages, and in any and all public buildings where the required source of power is available.

There is no expensive installation as the alarm is just screwed into any socket; if desired, an extension howler may be installed at some point remote from the detecting unit itself.

Courtesy The Gamewell Co.

A fire-alarm unit, self-contained, to be screwed into a lamp socket



A mobile astronomical observatory. See text below

Glass Wool "Shot From Guns"

IN a new and spectacular method for making glass wool, molten glass is sprayed out of a "gun," producing a high grade and very uniform result. The gun used is the Schoop pistol, ordinarily used to spray a metallic film on metal surfaces. In spraying molten metal, the metal is atomized, producing a homogeneous coating. When glass is sprayed from the pistol, no atomizing takes place, on account of the high viscosity of the glass. The glass wool produced by this unique method is said to be ideal for insulating purposes.—*A. E. B.*

Auto Telescope Mounting

WHEN a California astronomer decided to move his telescope—the largest privately-owned, Carl-Zeiss-made telescope in the country—from one location to another, in order to obtain the most favorable observations, engineers told him that it would be impractical to transport the telescope by automobile because of the excessive vibration and damage from jolts and road shocks.

He discovered, however, that when the huge telescope was mounted on a Ford coupe equipped with low pressure streamline Jumbo tires, road shocks were reduced to a point where transportation was practicable, and that, when the telescope was in use, there was even less vibration than when it was mounted on a solid concrete base. He believes this is due to the fact that the tires at low pressure absorb ordinary earth tremors.

Reducing Medicines

A POWDER or pill that will peel off the pounds of surplus weight without recourse to drab reducing diets is the dream of every fat man and woman. Many such are on the market, but they are potent substances, fraught with danger and warned against by medical scientists. No exception is the latest reducing medicine, the powerful and dangerous dinitrophenol. This yellow dye is a close chemical relative of picric acid. Cases of poisoning from it occurred in French munitions factories during the World War.

San Francisco physicians, Dr. W. C. Cutting, Dr. H. G. Mehrtens, and Dr. M. L. Tainter, of Stanford University School of Medicine, have investigated it and reported on its properties to the American Medical Association. The dye has an effect on the body something like that of thyroid gland extract, they found; it speeds up the body's metabolism and in large doses causes fever. The patients lost weight steadily without any dietary regulations, even when taking small doses of the chemical.

The San Francisco investigators suggested that the dye might be useful in cases of obesity and also in cases of the more serious condition of under-activity of the thyroid gland, especially as it does not cause the extreme irritability caused by equivalent doses of the glandular substance itself. It must be noted, however, that

Dr. Van de Graaff's electrostatic generator set up in an airship hangar

the danger of overdosage with this substance was strongly emphasized by the investigators and also by the American Medical Association.

In spite of this, the tragic death of a San Francisco physician from an overdose of the drug, taken in a desperate effort to lose weight quickly, has been reported. According to the attending physician, the victim was literally "cooked to death" by the terrific fever induced by the large dose he took of dinitrophenol.

Human nature being what it is, even this horrible warning may not be enough to avert similar tragedies in the future. It is, therefore, encouraging to learn that British scientists have found a chemical that promises to be safer than dinitrophenol. Dinitro-ortho-cresol is its name. It was described in *The Lancet*, English medical publication, by Prof. Edward Charles Dodds of the University of London and Sir William Jackson Pope, professor of chemistry in the University of Cambridge.

The dinitro-ortho-cresol compound appears from the British investigations to be more suitable for trial on patients, since about one third the amount is required to produce the same effect as with the dinitrophenol. Since the toxicity of the two compounds is about the same, the danger is thus reduced by about two thirds.—*Science Service.*

Man-Made Lightning for Science Research

THE huge Van de Graaff electrostatic generator, which recently underwent its first tests at the Round Hill research station of the Massachusetts Institute of Technology, is designed to develop direct current at approximately 10,000,000 volts. Up to the time the Van de Graaff generator was designed, science with the best means at its disposal had been able to obtain direct continuous current at less than 800,000 volts. The output of Technology's great generator operating at normal capacity is approximately 20 kilowatts, and may be further increased many fold, if desired. The use of this great generator for research is expected to mark the beginning of an era of extraordinary significance in which extremely high voltages will make possible investigation of some of the most fundamental secrets of nature.

This revolutionary generator was designed by Dr. Robert J. Van de Graaff, a member of the research staff in physics at Technology. The generator consists of two separate units, each with a polished aluminum sphere 15 feet in diameter resting on a hollow cylindrical insulating column 25 feet high and six feet in diameter. These columns are mounted on heavy four-wheeled trucks operating on a railway track 14 feet wide. This arrangement permits variation of the distance between the two great terminals and also makes it possible to move them into the open air to avoid flashes to the roof girders of the airship hangar, in which the generator is housed, a distance of more than 20 feet from the spheres.

In the generator as it now exists, endless paper belts, operating vertically within the hollow columns of each of the two units, run from driving motors in the bases to pulleys within the spheres. The electrical charge carried up by the belts is "sprayed" on the spheres at the base at the comparatively low pressure of 20,000 volts. The process is not unlike the old-fashioned method of raising water from a well by means of small buckets on an endless chain, each bucket dumping its load as it turns over a pulley at the top. In the generator the electrical charge carried up by the belts is taken off and stored on the surface of the big globes by means of "brushes" fastened near the upper pulley. Special air-conditioning machinery within the supporting columns of the machine maintains the proper atmosphere for efficient operation.

It should be noted that the belts in one sphere are storing up negative charges of electrical energy, while the belts in the other carry positive charges. When the store of electricity in each sphere reaches a potential of approximately 5,000,000 volts, the terminals will discharge at a combined electrical pressure of about 10,000,000 volts.

To the layman, one of the most amazing features of the generator will be the fact that while the machine is in operation the safest place for the research workers will be within the huge terminal spheres on which the high voltage charge is stored. The interiors of these aluminum globes will be compact laboratories with lighting facilities and various instruments for research. While the machine is running, the bodies of the men in the sphere will be charged to the full voltage of the terminal, but because they are insulated from the ground no harm will result.

This 10,000,000 volt generator was built for the specific purpose of atomic research —the bombardment of nuclei, the centers or kernels of atoms, which are known to contain the major portion of the energy in the universe. The huge generator, however, may have other significant uses, for whenever a new field of exploration has been opened by an important scientific advance, new and often unexpected applications have followed.

In addition to atomic research, some of the scientific problems which are expected to be investigated with this new tool of science are the production and study of X rays of many million volts, which may, among other uses, be very valuable in the treatment of disease; and the use of X radiation thus produced to extend knowledge of the relation between wavelength of radiation and absorption of matter to the region of much shorter wavelengths. Such a study should make possible, for example, a much more accurate estimate of the wavelength or speed of cosmic rays than is now possible, and would have considerable influence on the astrophysical theories of the fate of the universe.

White Buffalo, "Big Medicine"

AN albino buffalo was born last spring on the National Bison Range, maintained by the Bureau of Biological Survey, United States Department of Agriculture, near Moiese, Montana. The white calf is one of about 75 young born in the first half of 1933 in the herd of more than 400 animals.

Even when millions of buffalo lived on the great plains, a white buffalo was so rare that few were observed. "One or two in a lifetime was the utmost that any hunter secured," says Ernest Thompson

An albino, a rarity among buffalo, born on the National Bison Range

What Would You Like?

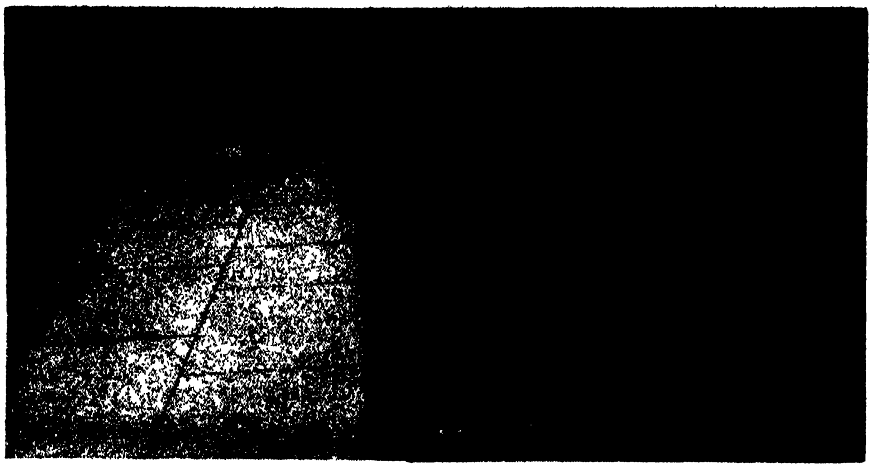
THIS is *your* magazine; it is edited to your taste to add to the sum of your knowledge of doings in all important branches of science and industry, to pass on to you practical information which will help you solve your industrial and engineering problems, to help increase your mental stature. We've recently made many improvements in SCIENTIFIC AMERICAN, have added extra pages, and for 1934 have planned a number of exceptionally fine articles by men of note. If you want a still better SCIENTIFIC AMERICAN, then give us the benefit of your opinions. Definite knowledge of your likes and dislikes will serve as a guide for the editors.

An executive of one of the country's largest industrial corporations recently told us:

> "SCIENTIFIC AMERICAN is of such value to our business that each copy is routed all over our plants through research departments and executive and management offices, and is clipped and annotated until it is literally worn out."

Write us on your business letterhead telling us what *you* think of its value. What criticisms and what suggestions have you? Mention some particular SCIENTIFIC AMERICAN item that has solved a problem of yours. Let us know what kind of articles you wish and who should write them. The majority vote will govern our future policy. By thus assisting us, you will be helping to make, for your own interest and profit,

A Bigger and Better SCIENTIFIC AMERICAN



A new composition flooring being laid directly over old wood

Seton, and Dr. W. T. Hornaday tells that he "met many old buffalo hunters, who had killed thousands and seen scores of thousands of buffalo, yet never had seen a white one." According to E. Douglas Branch, there was "only one white animal in the five million and more bison of the southern herd." Dr. Hornaday believed that "not over 10 or 11 white buffalo, or white buffalo skins, were ever seen by white men." A single albino was raised about 30 years ago in a herd at Pierre, South Dakota, says Dr. Robert S. Norton, Protector of the National Bison Range.

The Indians looked upon an albino buffalo with awe, considered it "big medicine," and for a good skin paid the price of 10 or 15 horses. Then piety, says Branch, demanded that three or fours years after the purchase, the skin should be offered to the wind and rain. The white man also was willing to pay a high price for an albino skin. Branch tells that the single albino of the southern herd fell to the gun of a plainsman, who sold it for 1000 dollars. So highly were the white buffalo prized that, said Hornaday, "not a single one, so far as I can learn, ever had the good fortune to attain adult size."

"The National Bison Range," says Paul G. Redington, chief of the Bureau of Biological Survey, "is maintained to assist in perpetuating the American buffalo, which at the time of the establishment of the range was threatened with extermination. We are, therefore, much interested in having in the herd an example of a variation so rare as the white buffalo. When only one was known in a herd of more than 5,000,000, it is particularly interesting that we should have this 'big medicine' in a herd of about 500 animals."

Permanent Floor Covering

FOR covering old wooden floors, aisles, and so on in factory, schools, offices, homes, and other public and private buildings, there is now available a strong, uniform, compressed fiber board called Stonhard Goverwood, which comes in sheets 45 inches long, 12 inches wide, and 3/16 of an inch thick. This material is placed directly over the old floor, as shown in one of our photographs, and nailed in position with six or eight penny nails.

The new surface thus obtained is practically dust free and can be washed or mopped. It may also be waxed and polished to improve the appearance, or can be painted after a priming coat is applied.

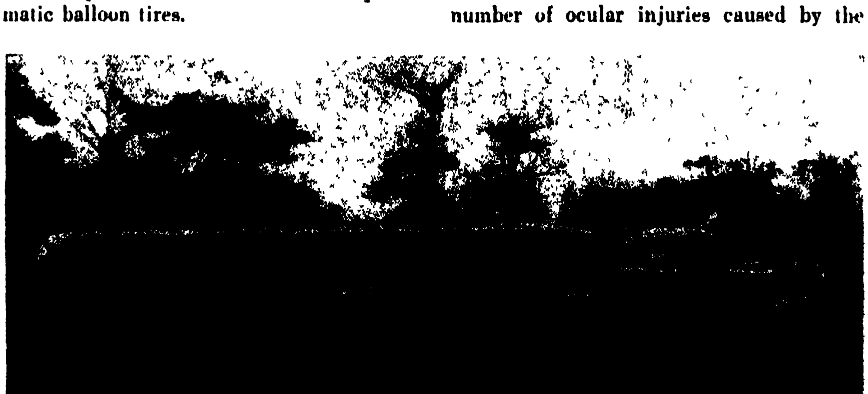
Noiselessness is one feature of this floor covering material as it acts to prevent reverberation of sound normally caused on wood floors by heavy walking or trucking. The surface is said to be resilient and consequently less tiring and more pleasant to those who have to walk or stand on it.

A Modern Desert Coach

IT has always been a long journey from Damascus to Bagdad—25 days by water, completely around the Arabian Peninsula. While these two ancient cities lie only about 500 miles apart, the distance between them is a trackless desert—no roads, no habitations, nothing but sand, terrific heat, and sometimes severe cold in the mountain passes.

What has been accomplished in solving the problem of overland travel between these two cities marks a new epoch in passenger bus construction. A bus has been built with an all-metal body, by Bender Body Company, that is dust-tight, insulated, and over 68 feet long, 8 feet 8 inches wide, and 11 feet high. It is fitted with spacious, comfortable reclining chairs, ample ventilation, cooled drinking water and other facilities. Everything has been foreseen and provided for comfortable, safe transportation under tremendous difficulties.

The tractor, by Marmon-Herrington of Indianapolis, has three driving axles powered by a 6-cylinder Diesel engine of 185 brake horsepower at 1600 r.p.m. (The tank at the rear of this cab holds 250 gallons of fuel oil, enough for a round trip.) The complete coach is carried on 18 pneumatic balloon tires.



Desert travel is both comfortable and speedy in this motor caravan

This caravan coach has both first class and second class passenger compartments, with front and rear inside storage spaces accommodating 6100 pounds of freight and baggage. Interior luggage shelves in the first-class compartment accommodate 2500 pounds. Additional luggage may be carried on the roof. The crew consists of conductor, steward, and three drivers. One driver sleeps in the berth located just back of the cab seat, while the others are in charge.

It is anticipated that this coach is the forerunner of a number of additional units for the Nairn Syrian Desert Service.

Perfuming Rubber

VULCANIZED rubber, while immensely useful, is not distinguished for its pleasant odor. Neither are the various accelerators and other malodorous substances usually incorporated in its manufacture. Hence, a good deal of work has been done by rubber chemists to de-odorize or covet up the smell of rubber. Writing in *India Rubber World*, Max A. Foley suggests that essential oils be used to perfume rubber, the controlling factors being the boiling point of the essential oil used and its cost per pound. He also presents a table of data with the results of some experiments carried on with a number of natural and synthetic perfume materials. On two batches of material, Foley reports results in which citranellol, cumarone, and pine-tar appear to have proved most satisfactory.—*A. E. B.*

Dangerous Eyelash Dye

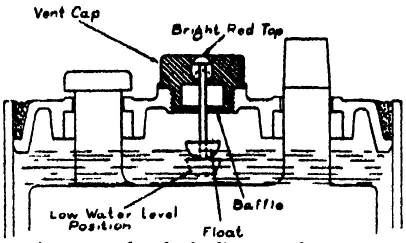
LETTERS received by the Federal Food and Drug Administration concerning injury to users of "Lash-Lure," an eyelash dye manufactured by Lash-Lure, Inc., Los Angeles, Calif., led W. G. Campbell, Chief of the Administration, to issue the following statement:

"We recently investigated the case of a prominent Dayton, Ohio, clubwoman who was made totally blind as a result of an application made by a beauty parlor operator, of this highly poisonous cosmetic. Lash-Lure, according to the *Journal of the American Medical Association*, contains an aniline dye which is extremely corrosive and capable of burning away the outer coating of the eyes. The Administration has investigated a number of cases of blindness or seriously impaired vision attributed to the use of this injurious eyelash 'beautifier.' The medical literature contains accounts of a number of ocular injuries caused by the

cosmetic. A number of these are printed on pages 1016 and 1017 of the *Journal of the American Medical Association*, September 23, 1933."

Battery Tester

THERE was a time when the average man could not test his automobile battery for water without wrestling floorboards, juggling flashlights, and swearing profusely. Apparently those days are over, for a battery water-tester has been invented which does everything except remove floor-



A water-level indicator for use in all types of storage batteries

boards. It permits the measurement of electrolyte by a glance, without the necessity of flashlight or eyestrain.

A plunger inserted in the battery cap suspends a float. The passage in which the plunger rests is large enough to permit the necessary escape of gases and at the same time give the operation of the plunger free play. The little red cap on the plunger is easily discernible when level with the battery cap. If it is not in view the battery needs water and as water is added the float rises gradually. Where there is sufficient water the red cap is exactly level with the battery cap (as shown in the diagram).

Thermoplastic Cements

A NEW line of products, known as du-Pont thermoplastic cements, has been perfected at the Parlin, New Jersey, laboratories of E. I. du Pont de Nemours and Company. These cements are composed of nitrocellulose or cellulose acetate plasticizers and synthetic resin of the modified polybasic acid-polyhydric alcohol type which are dissolved in suitable solvents. They are waterproof, very flexible, resistant to the action of oils and grease, and are not affected by mild acid and alkaline solutions. They do not become brittle on aging.

The surfaces which are to be joined together are coated with the cement by means of a brush, spray gun, or coating machine. This coating of cement is allowed to dry thoroughly, requiring about 20 minutes at ordinary room temperature. After the cement is thoroughly dry, the two surfaces are brought into contact, and heat and some pressure are applied. This fuses the cement film which on cooling becomes hard, joining the two surfaces and forming a strong, waterproof, flexible bond. Materials can be coated with this cement and stored for an indefinite period, the actual cementing operation being carried on at some future time.

Uses for thermoplastic cements range from laminating foil and paper or Cellophane for use as food wrap, to laminating thin metal sheets to composition board or ply-wood for use in the construction of commercial automobile bus bodies. They

(*Please turn to page* 103)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

PERHAPS the most onerous and dreaded job astronomers have to do is guiding when taking celestial photographs. No telescope, however well and delicately adjusted, can simply be set in motion by its driving clock and left exposing a plate on a field of stars. Even were the mechanism kept really perfectly in step with the earth's motion the variations in atmospheric refraction still would cause the star images to shift on the plate from moment to moment, and the result would be far from satisfactory on a long time exposure. Therefore the plate is set in a holder having screws which can shift it in two directions, and the astronomer sits with his eye glued to an eyepiece focused on some one star in the field, keeping that star on a pair of cross-hairs by shifting the plate with each little deviation. Why not let automatic machinery do this?

That is what L. Jackson Bulliet, of 7609 Fourth Avenue, Brooklyn, N. Y. had in mind when he submitted to us a memorandum containing an idea which he wishes to present for all and sundry to wrestle with.

"The following discussion," Mr. Bulliet writes, "is concerned with a device to eliminate the necessity for an observer giving constant attention to the guiding of a photographic telescope. It is believed that such a contrivance would not only save the photographer from an exceedingly tedious job on long exposures, but would also result in better pictures. The reason for expecting better pictures is that this device should respond at once to a drift so slight that it would not be noticed by a human observer. Thus, corrections would be more frequent than with the method now used, resulting, in effect, in a steadier position of the image on the plate.

"Considering Figure 1, the reader is looking into the top of a round light-tight metal box B. This box is divided, for its entire depth, into quadrants by the exceedingly thin opaque partitions P and P'. It may be well to make the actual partitions of glass, with one side of each coated with a thin opaque film. The films may then be regarded as the partitions here referred to. In each quadrant is mounted a photo-electric cell R, R', D and D'.

"Suppose now that this box is affixed to the eye end of the guide telescope of a photographic telescope in such a manner that the top of this box coincides with the focal plane of the telescope. The connection to the telescope must be light-tight, so that no light may reach the photocells except through the object glass of the guide telescope. The top edges of the opaque partitions now correspond to the cross-hairs of the guide telescope. The box is oriented as indicated by compass points on the sketch. That is, the cross-hairs (partitions) lie NE, SW, and NW, SE, with respect to the telescopic field. At the intersection of the cross-hairs (partitions) is an opaque disk M, slightly larger than the image of the object to be guided upon. This disk would actually be a spot on a removable glass cover or slide over the box, so that different sized disks could be used for different sizes of images. If the field of view included objects other than the one to be guided upon, an opaque diaphragm (not shown) with a center opening somewhat larger than the disk M, would have to be provided to keep the light from the other objects from reaching the photocells.

"So long as the object is centered on the cross-hairs (partitions), no light can reach any photocell because of the disk M. But any drift will cause the image to creep off the edge in some direction, so that light will fall into one or two (if over one of the thin partitions) of the compartments where it can affect the cells in them. This

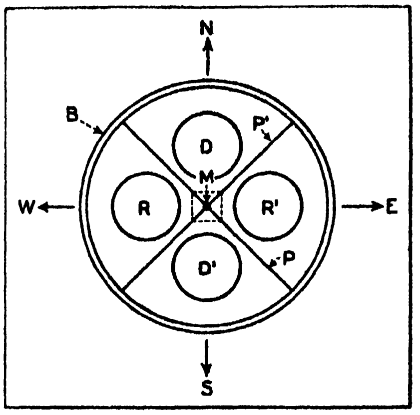


Figure 1: **Photocell layout**

effect could be greatly enhanced by fitting a triangular mirror into the corner of each quadrant, to reflect the light directly into the cell. The apex of the mirror would be at the top and the base at the bottom of the box, so that the four mirrors would form a pyramid. Perhaps a better arrangement would be to leave out the partitions entirely, and place in the center of the box a square based pyramid of optical glass with its faces silvered and with its apex just under the disk M. This pyramid would be oriented as indicated by dotted lines in the figure. The rest of this discussion will continue to refer to the partitions and the rest of the arrangement as first described, but the argument would not differ essentially in the pyramid scheme.

"Referring now to the wiring diagram, Figure 2, it is seen that each photocell feeds through an amplifier into a relay. The relays associated with the cells R and R' control a reversible electric motor C, which drives the regular slow motion screw on the right ascension axis, or a special screw provided for the purpose. Likewise, the cells D and D' control the similar motor C', on the declination screw.

"Should the image in question drift toward the northward with respect to the cross hairs (partitions), the cell D would function to start the motor C' in proper direction to compensate for the drift. Similarly, a drift to south would start the same motor in the opposite direction; and the same reasoning applies to drifts in right ascension. The more general case, of course, is that in which the drift is in some direction other than the cardinal compass points. The light would probably fall in only one quadrant in this case but, the correction being in a cardinal direction, the light would fall into another quadrant before it got back to the center. Thus the correction would be brought about by motions in right ascension and declination successively or simultaneously (the latter when the image falls on a cross-hair).

"It will be noted that the circuit to start a motor includes contacts of both relays associated with that motor. Thus the operation of one relay will not start the motor unless the other relay of the pair is unoperated. The idea here is that in time of poor seeing the image might become fuzzy and larger than the disk M. In that case, both cells associated with each motor would be energized. Neither motor, however, would start, due to the relay circuit. In other words, any anomalous condition tending to bring about directly opposing corrections would cancel out.

"Another possibility in times of poor seeing would be rapid shifting of the image in random directions. This would tend to bring about incessant efforts to correct for erratic motions for which corrections are inherently impossible due to inertia of the telescope mechanism. By using relays of the type which have a slight lag in their operation, these rapid shimmerings would not operate the relays and so not start the motors. Only true drift would be corrected for."

WE passed this communication to Mr. Alan R. Kirkham of Tacoma, who commented as follows:

"The photocell tracking device interests me. As a radio nut, the thing looks OK, except for the terrible cost, and awful difficulties of making large amplifiers work. The worst bug I see is this: the gadget that splits the rays is much larger than a star image. The prism, for example, cannot be made with edges good enough. The size of a star in the focal plane of a very good 12-inch telescope runs from 1/2000 to 1/10,000 inch in diameter, depending on the focal length."

The above comment was relayed back to Mr. Bulliet, who replied:

"As I wrote the paper, the apex of the pyramidal prism was to be placed exactly in the focal plane of the guide telescope objective. Now, as Mr. Kirkham points out, the said apex would necessarily be somewhat larger than the image of the star on which we are to guide. Hence the star may drift more than its own diameter before light will have a chance to strike one of the sides of the prism and be reflected into a photocell. That would, of course, be an intolerable drift. But suppose we introduce a convex lens or lens system between the

focal plane of the objective and the prism and put the prism back far enough so that it will be in the plane of the new image (equivalent of using eye-piece and eye and putting the prism at the retina of the eye). Now the drift will be greatly magnified (assuming proper placing of the new lens) but the dimensions of the prism have not changed. Also, if we are dealing with a star, the actual image of the star will not be increased. It seems to me that the new arrangement should work all right because the secondary image of the star will move several times the width of the prism point

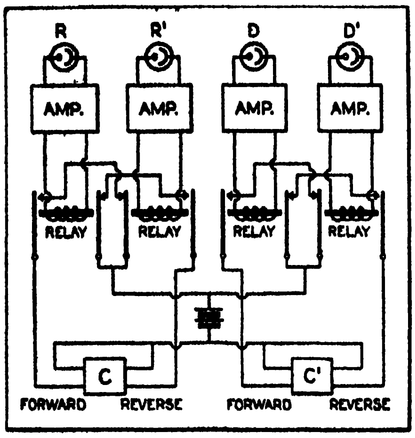


Figure 2: Wiring diagram

before the primary (photographic) image has moved a perceptible distance."

Well, there you are, folks, just as these two left it—probably in a pretty raw stage at present but ready to be improved and made to work. Somebody ought to derive some fun perfecting this thing—not to speak of the fame.

SEVERAL workers have inquired about making rifle telescope sights, and we have advised them that we had no data but to go ahead and see what they could finally work out and then make their findings available to the rest of the amateur telescope-making fraternity who might have similar interests. An effort of this kind is being made by Harry A. Peck of 205 Kenmore Avenue, Youngstown, Ohio, who is also making a rifle—barrel, receiver, bolt and all—while he is at it. He says the telescope sight will cost him around 35 dollars, not to mention his time. Those who may be interested in this endeavor might well pool their knowledge with Mr. Peck.

LAST month we omitted a credit line and we hope we can make amends by saying here more than the credit line could have said, had we not plain forgotten it. On page 28 of last month's number there was a short article about Professor R. W. Wood and his original inventions, including infra-red photography, and one illustration used with that article showed the Empire State Building in New York, taken from a distance of 18 miles (Paterson, N. J.) with a six-inch telescope, by infra-red photography. What was omitted, Professor Wood tells us, was the photographer's name, Mr. Garret Hobart, Jr. We don't knowingly suppress such things but we do sometimes unknowingly forget them. Taking that picture was quite a feat.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

STUDIES IN SOCIAL SCIENCES 1933 (Engineering and Science Series No. 43) contains seven theses for the degree of Master of Business Administration and deals with important public affairs such as "A Study of the Relation Between the External and Internal Value of the Pound Sterling 1920-1932" and "A Study of the Trends in the Cost of State Government in New York 1900-1931," and similar subjects. *Rensselaer Polytechnic Institute, Troy, N. Y.—Gratis.*

PROCEDURES IN CURRICULUM MAKING (Bulletin, 1932, No. 17, Monograph No. 18, National Survey of Secondary Education), by Edwin S. Lide. The purpose of this study is to indicate the details of organization and the specific procedures in programs of curriculum revision. The subject is a curious one and has probably employed some of our best educational minds. *Superintendent of Documents, Washington, D. C. —ten cents (coin).*

THE GUARANTY OF BANK DEPOSITS (Bulletin No. 3) is a report of the Commission on Banking Law and Practice Association of Reserve and City Bankers. The Association was organized in 1912 to provide a medium for the exchange of ideas among its members on matters relating to banking law and practice. It has hitherto confined itself largely to what may be termed laboratory work in the field of banking. However, the present emergency called for a somewhat different policy, so a Commission on Banking Law and Practice was appointed to undertake an analysis of the banking system as a whole, with recommendations for strengthening the banking structure. *Address J. J. Schroeder, 162 West Monroe Street, Chicago, Illinois.—Gratis.*

RESERVOIRS FOR FARM USE (Farmer's Bulletin No. 1703), by M. R. Lewis. Water is so useful on the farm that it is a wonder that farm reservoirs are not in more general use. The pamphlet gives a wealth of information. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE CARE OF LEATHER BELTS is a large wall chart giving all the information. It is filled with tables and diagrams. *E. F. Houghton & Company, Philadelphia, Pa.—Gratis.*

KOHLER ELECTRIC PLANT. The Kohler engineers have just developed an 800 watt, 32 D. C. unit which will prove very useful for farms, summer homes, yachts and boats, filling stations and garages. Four models are available—two battery charging types and two non-battery plants delivering direct-from-generator service. The circular is a guide to the type of independent unit required. *Kohler Company, Kohler, Wisc.—Gratis.*

THE LOUIS ALLIS MESSENGER deals with the problem of selecting the correct motor for any job. This is a bi-monthly publication dealing particularly with splash-proof and explosion-proof motors. *The Allis Company, Milwaukee, Wis.—Gratis.*

LUBRICATING OF GRAIN HANDLING MACHINERY (*Lubrication*, Vol. XIX, No. 11, November, 1933) deals with installations of grain elevators and the handling of grain from ships. Flash and fire points are considered. *The Texas Company, 135 East 42nd Street, New York City.—Gratis.*

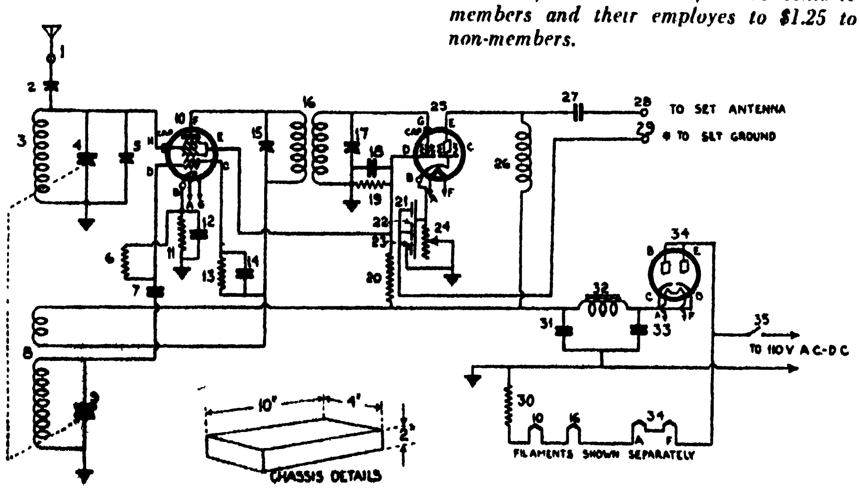
PUBLICATIONS OF THE DOMINION OBSERVATORY, Ottawa (Volume 4, Bibliography of Seismology No. 14, April, May, June, 1932), gives a bibliography in all languages and was prepared by Ernest A. Hodgson, *Department of the Interior, Canada. Ottawa —25 cents.*

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA FOR THE YEAR ENDED DECEMBER 31, 1932, prepared by Mr. Slason Thompson, Bureau of Railways News and Statistics, is one of the most valuable reports in the railway world. Mr. Thompson compares his figures with the official reports for 1931 and also gives the recent statistics of foreign railways which are so difficult to obtain. The railroads that have gone "modern" and streamlined are included. *Slason Thompson, Daily News Building, Chicago, Illinois.—Gratis.*

THE NETHERLANDS INDIES—A JUBILEE ALBUM was issued to commemorate the 25th anniversary of the travelers' official information bureau of Netherland India. The travel literature issued in far away Batavia is the peer of the best travel literature issued in Europe. We are frank to confess that these publications we have noted from time to time have given us a wanderlust that may never be fulfilled, but those going around the world or to Australia will find the trip to the many islands both easy and fascinating. *Travelers' Official Information, Bureau of Netherland India, Batavia, Java.—Gratis.*

THE ORIENTAL INSTITUTE. This book forms Volume XII of the University of Chicago Survey, by Dr. James Henry Breasted. The entire scope of the survey embraces some 40 or 50 projects, which are being grouped in a series for purposes of publication. A comprehensive survey of a large research enterprise is a new undertaking in educational administration. It is beautifully illustrated showing the latest researches of the thirteen expeditions. *University of Chicago Press, Chicago, Ill.—$3.00 bound in cloth.*

TURBINES (Publication A.3 August, 1933) is a valuable pamphlet, including operating records of 291 large turbines for 1932, and figures covering records for 1932 of 12 turbines operating above 1000 pounds steam gage, together with additional data. *Edison Electric Institute, 420 Lexington Ave., New York City.—Price varies from 75 cents to members and their employes to $1.25 to non-members.*



THE FIND-ALL PENTAGRID A.C.-D.C. SHORT-WAVE CONVERTER is a self-powered three-tube converter which changes any broadcast receiver into an efficient short-wave set. Through the use of Alden plug-in short-wave coils, the band between 15 and 200 meters may be covered. One of the features of this converter is the use of the new 6A7 pentagrid tube, which combines the functions of detector and oscillator. A second feature is the "Clain" A.C.-D.C. circuit which dispenses with the customary power transformer. The set will work equally well whether the power source is A.C. or D.C. This converter is simple in design and construction—hence it is easy to build. It can be used either with tuned r.f. or with superheterodyne broadcast sets. The Noise-Master lead-in is another feature. Top and bottom views, list of parts and additional information may be obtained from *Allied Engineering Institute, Suite 541, 98 Park Place, New York, N. Y.—10 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 99*)

can also be used for cementing metal foil to metal foil or to other materials; glass to glass or to other materials; Bakelite to Bakelite or to wood, glass, metals, and so on.—*A. E. B.*

Lung Ventilation Measured

A METHOD of using X rays to find just how efficiently a person's lungs are being ventilated was described by Dr. Walter W. Fray of Strong Memorial Hospital, Rochester, New York, at a recent session of the American Congress of Radiology.

Apparently some patients suffering with tuberculosis and other lung diseases have more difficulty with breathing than would be expected from the amount of lung tissues that is seen in X-ray pictures to be affected, while in other cases the patients are able to breathe with little or no difficulty in spite of a large diseased area. Lack of a standard of the ventilating efficiency of normal lungs has handicapped physicians in determining the extent of disability along these lines.

Dr. Strong and associates worked out a method of determining the normal pulmonary ventilation, and then used the method in over 100 cases of various kinds of lung diseases. It proved to be useful in the following ways: In following the progress of chronic forms of pulmonary disease such as pulmonary emphysema, asthma, chronic bronchitis and bronchiectasis; in assaying the degree of disability in industrial disease such as silicosis for purposes of compensation; in identifying suitable cases of tuberculosis for treatment by collapsing part of the lungs; in determining the presence or extent of disturbed ventilation in cases of a certain kind of heart trouble; and, finally, in establishing both the diagnosis and progress of chronic pulmonary disease.—*Science Service.*

High Compression—High Economy

FUEL savings as high as 29.6 percent are revealed by motor tests of high compression ratios conducted by engineers of the Ethyl Gasoline Corporation. A large six-cylinder commercial engine, of the type which must carry heavy loads over steep grades, was employed for the trials. Data were gathered over a range of loads at constant speed and two compression ratios, 4.03 to 1 and 5.48 to 1 respectively.

Charts of the tests carried out showed that the low compression unit in first gear is capable of supplying considerably more power than is necessary to propel the vehicle on the grade considered, although there is not sufficient power to operate in second gear. Consequently, the governor throttles the air-fuel mixture flow into the engine so that it develops only 70 horsepower, thus driving the truck at seven miles an hour, which corresponds to the governed speed of 2100 revolutions per minute for the engine.

The high compression engine, utilizing the best grade of anti-knock fuel, will drive

the same truck up the same grade in second gear. With the combination of high compression and second gear, the vehicle speed may be increased until the available horsepower is exactly equal to the horsepower required, which happens to be at a speed just slightly less than the governed speed of the engine. Consequently, the high-compression truck climbs the grade in second gear at a little more than 14 miles an hour, developing 142.5 horsepower as it does so.

The low compression engine developing 70 horsepower at the reduced throttle opening consumes 0.76 pounds of fuel per horsepower hour or at a total fuel consumption rate of 53.2 pounds per hour. Since the vehicle speed is seven miles per hour, the fuel consumption per mile is 7.6 pounds.

The high compression engine, however, operating at nearly wide-open throttle develops 142.5 horsepower at a specific fuel consumption of 0.53 pounds of fuel per horsepower hour. Since the vehicle speed is 14.12 miles per hour, this results in a fuel consumption per mile of 5.35 pounds, or a decrease of 29.6 percent below the low compression fuel consumption rate for the same grade.

Moonlight Indoors

THE ready banishment of such night-time terrors of household darkness as bogeymen, barked shins and bruised toes has been made possible through the development of two types of All-night lamps by G. F. Prideaux, General Electric engineer at Nela Park, Cleveland, Ohio.

The new lamps, which emit illumination intensities comparable to moonlight, are of three-watt consumption and employ a recently developed tungsten filament wire so fine as to be almost invisible to the naked

Two sizes of tiny lamps designed for use in the home as night lights

eye; one that is only three ten-thousandths of an inch in diameter.

Flexibility in the application of these lamps has been provided, as they are made with standard prongs that plug into the baseboard or other convenience outlet. Adding the screw part of a standard attachment plug permits them to be used in any regular socket. A choice in the amount of light desired is possible, as the output of the little lamps ranges from approximately

one lumen for the smaller size which is equipped with a resistor, to twelve and one-half lumens for the larger size which operates on regular line voltage.

All-night lights may be used for protection, safety, convenience and as an assurance that all is well for the little tots who dislike going to sleep in the dark. Statistics show that crime is lessened where light is provided. Intruders hesitate to enter homes where they could be quickly seen by an awakened member of the household.

In addition, the small night light in a dark room proves of assistance in finding the electric switch. That people do desire assistance in this direction is evidenced by the thousands of luminous buttons that are made and sold every year.

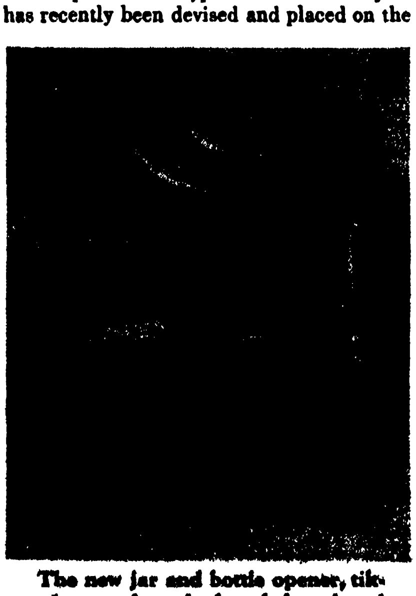
Waste Products Improve Cadmium Plating

CADMIUM plating has been growing in popularity because of its beautiful, non-tarnishing finish of excellent wearing qualities. The technique of cadmium plating is still somewhat uncertain, and it was therefore a topic of lively discussion at the recent convention of the Electrochemical Society. R. A. Claussen and H. L. Olin, of Iowa State University, reported on their experiments to improve the quality and efficiency of cadmium plating by the addition of various substances to the plating solution. With the proper addition agent, higher current densities may be used and the throwing power is improved. The experimenters found that the desired effects were obtained by the use of "Steffen's waste"—a byproduct of the sugar industry and also by the use of the water in which corn is soaked in the manufacture of cornstarch.

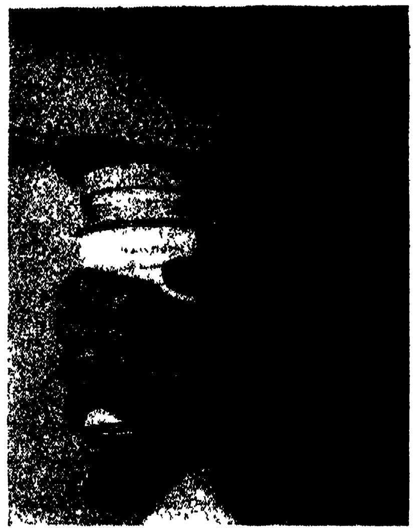
While this discovery is interesting and perhaps useful, it seemed to be the general opinion of the electrochemists present that the ideal addition agent for cadmium plating, when discovered, will probably be a relatively simple and readily obtained substance.—*A. E. B.*

Opens All Bottles and Jars

A CLEVER little device for removing the tops from all types of bottles and jars has recently been devised and placed on the



The new jar and bottle opener, tilted up to show the knurled steel stud



Both hands may be used to grip the jar when using the new top remover

market by W. N. Lurcott. It consists of a single casting of light metal with a knurled steel stud firmly fixed in place as shown. Any size cap, from a small toothpaste tube to a large preserve jar, can be firmly gripped and removed with little exertion. The cap is merely placed between the knurled stud and one or the other of two curved flanges. Then with both hands pressure can be exerted and the cap readily loosened. A notch in the casting permits removal of crown caps.

This device is to be screwed to the under side of a kitchen shelf or cabinet and thus becomes a permanent fixture always ready for use.

Frozen Rum Punches Made At Dinner Table With Dry Ice

POINTING out that Americans have always liked their drinks cold, Lewis C. Chamberlin, manager of the solid carbon dioxide division of the Michigan Alkali Company, said that now they can have their drinks frozen. Whisky or rum punch can be frozen at the table before the eyes of guests, and be eaten with a spoon like ice cream or sherbet.

The trick of making frozen rum punches is not difficult, according to Mr. Chamberlin. A jigger of water, a jigger of rum, and a tablespoonful of sugar or honey are mixed together in a glass. Proportions may be varied to suit various tastes. To this is added a tablespoonful of powdered dry ice, which can now be obtained at almost any soda fountain. The punch is stirred as the dry ice is dropped in slowly, and in a minute the punch is frozen to a consistency of sherbet. A cherry adds to the attractiveness of the punch. Care should be used in handling dry ice, as it has a temperature of 109 degrees below zero. It should not be touched with the hands, for it will cause burns. Dry ice is solid carbon dioxide gas, the same gas which makes the fizz in champagne. Some of this gas remains in the frozen punch and adds greatly to its appetizing qualities.

Frozen cocktail lolly-pops are another novelty which will be popular. They are easy to make. A cake of dry ice is used, on the top of which recesses are chopped

out, and the cocktails are poured into the depressions. Sticks are held in the cocktails as they freeze, which takes but a moment.

Many other novel frozen liquor concoctions can be made with dry ice, and Mr. Chamberlin predicts that dry ice will be as necessary to the modern post-prohibition bartender as oranges and lemons were to those of bygone days.

Industrial Uses of Ultra-Violet

ULTRA-VIOLET radiation, sometimes in conjunction with visible light, is being used in a large number of industrial processes. In the textile industry it bleaches the best quality of linen; in the petroleum industry it removes bloom from lubricating oils; in the leather industry it enters the final step in the manufacture of patent leather. For the sterilization of water for public supply, the manufacture of various beverages, and, through its bactericidal action in the preservation of food, the ultraviolet ray finds wide use. Artificially-generated ultra-violet is also used in the food industry to increase the vitamin-D content of foods and, in some cases, to improve flavor, while various pharmaceutical preparations are likewise subjected to artificial ultra-violet radiation in order to secure certain specific properties.

Other uses of ultra-violet radiation, not yet extensive but which have been discussed occasionally, include the production of scrim oil in linoleum manufacture, the final treating of oil-cloth to remove stickiness, the bleaching of oil for food and technical uses, the synthetic manufacture of rubber from unsaturated compounds such as vinyl chloride, and the manufacture of chlorinated solvents from chlorine and hydrocarbons, such as chloroform—*A. E. B.*

YOU HAVE ONE CHANCE IN A HUNDRED TO UNDERSTAND EINSTEIN

(*Continued from page* 73)

crease is due to increased opportunity. It is idle to speculate whether the increase may not again be tenfold in the next 30 years. If we plot the number for each year, draw a smooth curve as closely as possible through the points and extend the curve in approved statistician fashion, the graph would indicate around 4000 for 1960. However, this signifies nothing for our purpose.

The psychologists who make mental tests consider that, ranging a large number of people in the order of their intelligence, the upper ten percent are very superior. The upper one percent are, I believe, all sufficiently intelligent to become psychologists, if they should consider such a course desirable, but are also wise enough to observe that this would lead to deplorable overcrowding, so that the great majority end by pursuing other learned professions.

The population of the United States, in 1930, was 122,775,046. Accordingly, there are over 1,000,000 people in this select class. Reference to any good atlas will give the corresponding figures for the other civilized countries of the world. Confining our attention to the United States for the time being, it is possible, I believe, that a person of this class, given the time and the inclination, might successfully pursue

the studies necessary to understand the theory of general relativity. However, considering only those above 21, the number would be about 700,000. If we wish to be safe in our guess, let us say at least 70,000, and possibly 7,000,000, persons in the United States may possess the necessary intelligence. We shall have to wait for some psychologist actually to measure the mental capacity required to tell which figure, if either, is correct. And we may have to wait for some time, for it would appear necessary that the psychologist should understand the subject very thoroughly himself, in order to work out the tests. At present the psychologists are too busily engaged in keeping abreast of the new developments of psychology, to find time for the study of relativity, and the relativists are not also becoming expert psychologists. It looks like a promising field for an aspiring pioneer.

PERHAPS some of my readers, assuming that they should be included in this group of persons with high mental endowments, but lacking the opportunity of attending a graduate school of science, would like to know how long it would be necessary to study, and what subjects should be pursued, in order to be ready to read the paper mentioned with understanding. The average student probably reaches the subject in his seventh year of collegiate work. However, his entire seven years are not spent solely on preparation for Einstein. Assume that our aspirant is a high-school graduate. The equivalent of collegiate undergraduate mathematics would take him through higher algebra, analytics, calculus and the elements of differential equations. The various universities differ somewhat in their requirements and in the methods of evaluating them, but a fair average would probably be about 30 quarter units for a first class grounding in undergraduate mathematics. This would represent perhaps 1000 hours of actual work—hard work, mental concentration. To be safe, let us require an equal amount of physics, which would include mechanics and electricity. Add a pinch of astronomy and stir well.

There are some text-books of mathematics, designed for engineers, which contain in one volume all that should be required, except in algebra. Now add to this approximately 2000 hours a course in theoretical physics, perhaps nine quarter units, some study of determinants in mathematics, a course in the calculus of variations, a study of vector analysis, non-euclidean geometry—perhaps 600 more hours in all . . . just absorb that, brother, and then go after Einstein.

It might be possible to do all that in a year, or, if you give two hours per day to the purpose, in four years. If you don't understand him then, perhaps the trouble is that, when we stand the adult population in a row, ranged according to their mental capacity, and count off, you will be Number 7,000,001. That will be a high rank, anyway.

It is possible that an individual with enough intelligence (please don't ask me how much is enough) could, after working through calculus and differential equations, be able to understand a book like the treatise by Weyl, translated under the title of "Space—Time—Matter." However, it would be best to study first a text-book on

theoretical physics, designed for first year graduate students. There are a few which are suitable. They will be difficult but, after all, it is mainly a matter of hard work and determination . . . and interesting, every bit of it. Even if you are sidetracked along the way, and never get to general relativity at all, you will have a most enjoyable time. When George Bernard Shaw wrote a play, laid far in the future, the only satisfactory occupation he could find for his very advanced super-men, in the multitudinous years allotted to them for their span of life, was to ponder on the theory of numbers.

It is quite possible that the exposition of the principles of relativity will, in the future, be greatly clarified. The present workers in the field are writing for their fellow specialists. However, the full mathematical theory will probably not be simplified to such an extent that it will be understandable by students with less than graduate work or its equivalent; at least, not for some time. And most of us, even in the upper ten or one percent, do not have the time to give to the study of mathematical physics, purely as an avocation. There are other things in life. Still, we would like to know something about relativity, just as we should know something about Newton's work, and the Copernican system, and many other subjects. We will ask, then, is the knowledge which a layman may obtain from a perusal of various books treating the subject in a popular manner, of any real value?

To answer that question in detail would be quite an undertaking. It should probably be considered in connection with an investigation to discover how many people are capable of misunderstanding Einstein.

NEARLY all of the books written for the lay reader contain a large amount of material which is not relativity, but merely an outline of certain conceptions of elementary physics and geometry. It is, of course, necessary to state these for the benefit of the student without technical training, but these portions, unfortunately, are hardly ever clearly distinguished as such. The unwary reader gains the impression that certain things are Einstein's discovery, when as a matter of fact they have been common knowledge to physicists, sometimes for a hundred years or more. They should be distinguished as background; important, of course, but not the main show.

On the other hand, none of the books attempts to give a popular idea of what tensors are. I believe it would be quite possible to offer such an exposition, which could be comprehended by at least 2,000,000 readers. The high school algebra text of the present day contains concepts which first required the genius of a Descartes to formulate. A description of tensors could possibly be made understandable to anyone who has mastered high-school mathematics. Not that the reader would thereupon be able to recognize a tensor at sight, or to contract or differentiate them. But he would at least know what kind of things they are, and wherein they differ from abracadabra.

On the whole, the knowledge which the reader will gain of the methods and results of the theory of relativity from the best popular works of the present, will be on a par with his knowledge of other important and significant subjects.

Books SELECTED BY THE EDITORS

NEW INTRODUCTORY LECTURES ON PSYCHOANALYSIS

By Sigmund Freud

FREUD'S notable work on psychoanalysis appeared in 1916 and now come these new lectures by Freud. Their purpose is to bring the student of psychoanalysis up to date with regard to the Freud interpretation. Readers who have already studied Freud will find much that is new and understandable in this book, which contains, in 249 pages, seven lectures respectively on the Revision of the Theory of Dreams; Dreams and the Occult; Anatomy of the Mental Personality; Anxiety and the Instinctual Life; Psychology of Women; Explanations, Applications and Orientations.—$3.20 postpaid.—*A. G. I.*

MAN AND THE VERTEBRATES

By A. S. Romer, Prof. Paleontology, Univ. Chicago

AN authoritative account of the evolution of man and the various forms of life ancestral to him, all the way back to the earliest animals having a vertebra. This volume is used as outside reading in a course in biology at the University of Chicago. It includes a splendid account (90 pages) of the mammals, living and extinct, other than the primates; another of the primates; a 30-page account of human origins; a shorter one of the human races, and a 132-page account of the human body. There are 415 pages and 278 illustrations.—$3.15 postpaid.—*A. G. I.*

TATTOO

By Albert Parry

THE author's subhead of this curious and intriguing book at once attracts attention: "Secrets of a Strange Art, as Practiced by the Natives of the United States." Beautifully illustrated with three color-plates and numerous half-tone reproductions, the book accomplishes its avowed purpose of getting under the skin of the skin game. The reasons for having tattoo applied to one's person are proved to be essentially psychological, whatever the expressed reason of the tattooee may be. Mr. Parry, supported by the assertions of authorities in the field of psychology, shows that there is a close linkage between tattooing and sex. There is a definite erotic basis for the practice of the art, and the author follows the line of reasoning with skill and tact. Such is the subject matter that parts of the book become hilariously humorous, but never get out of hand, and are always done in good taste in keeping with the vast amount of serious research that

One of the striking illustrations in "Tattoo," reviewed on this page

preceded the writing of the volume. If you have ever been tattooed—and it is shown that a surprisingly large number of men and women have—or have ever seen examples of the art, you will want to read this book both for its deep human interest and the amazing information that is revealed. There is a valuable chapter on the removal of tattoo marks. Beautifully printed on fine paper with illustrations inserted. $6\frac{1}{4}$ by $9\frac{1}{2}$ inches, carefully bound in stiff cloth covers.—$3.20 postpaid.—*A. P. P.*

AND THAT'S WHY

By W. Maxwell Reed

THIS book of 104 pages explains various natural phenomena and is for children of 10 to 12. The chapters are: Ducks, Clouds, and Teakettles; Frost; Mountains, Dewdrops, and Clouds; A Black Thunderstorm; Lightning and Tiny Drops of Water; Fire and Atoms; Salt Water, Rain, and Rocks; Lightning, Mr. Edison and Electric Lights; Sea Shells; Gasoline and Muddy Water; Thunder, Music, and Waves in the Air. After reading it, J.V.I., aged 10, wrote: "I think that this book is very interesting. It explains things that are often questions in the minds of children. I enjoyed it."—$1.40 postpaid.—*A. G. I.*

INTERNATIONAL BOOK OF NAMES

By C. O. Sylvester Mawson

HERE is a dictionary that business men, public speakers, teachers, commentators, and many others will find to be an invaluable reference. A vast amount of research has been necessary to compile this book, and much of the material comes from first-hand information. Spelling and pronunciation of names of modern celebrities and geographical names are accurate and authentic, and the data are up-to-the-minute in every respect. A chapter of 73 pages deals with pronunciation, and constitutes a source of information that would be difficult to locate elsewhere. 308 pages, 5 by $7\frac{3}{4}$ inches, well bound with stiff cloth covers.—$2.15 postpaid. —*A. P. P.*

GOOD EYES FOR LIFE

By O. G. Henderson and H. G. Rowell

THE scope of this book is what the average intelligent person would like to know about his own eyes and their care. It explains the eye machinery, and the more common eye troubles. It cites the various theories of eye changes and shows us how to avoid some of them by intelligent use of the eyes. Reading parts of this book would be a good prescription for that boy or girl of yours who insists on reading when lying down, slumped down, and so on; and incidentally some grown-ups might profit similarly. It is elementary and could be understood by anyone.—$2.15 postpaid. —*A. G. I.*

THE INVENTOR AND HIS WORLD

By H. Stafford Hatfield, Ph.D.

THIS book concerns the philosophy of invention, rather more than its very practical, immediate side. It also gives some instruction for handling inventions but these are not very concrete. It discusses many subjects which would interest inventors and particularly does it point out pertinent details with regard to inventing in certain fields, such as mechanical invention, chemical invention, electrical invention, biological invention, psychological inventions, and so on. It has 254 text pages and a bibliography.—$2.60 postpaid.—*A. G. I.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar

The "Chipso" Trade Mark*

By JOHN C. PEMBERTON

THIS widely known trade mark to women and many men has recently been canceled by the United States Patent Office (J. L. Prescott Co. v. Procter & Gamble Co., 19 U. S. Pat. Q., 75). [See page 55, January SCIENTIFIC AMERICAN. Editor.]

This comes as a complete surprise to the majority of people and has caused the general belief that the mark "Chipso" can never be used hereafter or again. How could this popular mark be canceled now—after having been registered in the Patent Office since April 12, 1921, and after Procter & Gamble's very great expenditures in advertising soap chips, flakes and granulated soap under this mark? The reasons are as follows:

(1) A cancellation proceeding may be instituted in the Patent Office at any time; literally there is no time limit (Corning v. Robertson, 65 F., 2d, 476).

(2) The Patent Office felt that "Chipso" was confusingly similar to the Prescott Company mark "Chase-O," which had been registered with them seven or eight years *before* Chipso, i. e., December 9, 1913.

(3) The Patent Office felt the Prescott Company's preparation (called Chase-O) in crystal form for washing, cleansing, and bleaching to be of the same class as Procter & Gamble's Chipso products -within the meaning of the trade-mark statutes, as lately construed by the United States Court of Customs and Patent Appeals.

Hence, these two marks applied to the same class of goods having been found confusingly similar—the younger mark, Chipso, had under the statutory law to be canceled in the Patent Office at the behest of the owners of the older registered trade mark, "Chase-O."

By and large, this cancellation is considered unjust and highly technical. And so it would be if its results were actually as they are commonly thought. But they are not. For the Procter & Gamble Company can and will (so far as known) continue to use this well-known mark for its well-known products. This apparent flouting of the Patent Office tribunals is legally and commercially possible and frequent because the right to *use* your trade mark is one thing, and the right to *register* it is altogether and quite another.

The result of the foregoing decision is, then, simply this, viz.:

(1) Procter & Gamble can no longer have its mark "Chipso" *registered* in the United States Patent Office—provided the latter's action is sustained by the appellate court sitting over it in such matters; that is, the United States Court of Customs and Patent Appeals.

(2) Procter & Gamble can none the less *use* its mark "Chipso" and sell its goods so marked exactly as before.

*Courtesy *The New York Law Journal.*

The apparent anomaly and absurdity of one company owning a trade mark in the Patent Office and another owning the same mark (or a confusingly similar one) outside the Patent Office is due to the fact that the Patent Office has no statutory jurisdiction to decide who may *use* trade marks, but only jurisdiction to decide who may *register* marks with them.

Therefore, before the Prescott Company can prevent the Procter & Gamble Company's use of the mark "Chipso" it will have to conduct a successful suit in the United States District and appellate courts (or, in the alternative they may elect to sue for an injunction in the *state* courts—Tiffany v. Tiffany, 147 Misc., 679, 264 N. Y. S., 459). In other words, it must be established to the satisfaction of our judicial tribunals that our administrative tribunals in the Patent Office were correct in concluding that the public would likely be confused by the similarity of "Chase-O" and "Chipso" on the same class of products.

The same conflict of trade-mark ownership has recently arisen with regard to "Del Monte" coffee. One company has a trade mark registration of the mark in the Patent Office on various food products, and has as well the right to use it in most of the United States, but not on coffee in California, Oregon, Washington, Montana, Nevada or Arizona, where another, judicially and commercially, reigns supreme (Tillman & Bendel v. California Packing Corp'n, 63 F., 2d, 498).

In the same way it has been conceded that although "Chicken of the Sea," as applied to young tuna fish, is the registered trade mark of the Van Camp Sea Food Company, neither the Patent Office nor the Court of Customs and Patent Appeals (sitting over it) has jurisdiction to decide whether the Van Camp Sea Food Company has the right to the exclusive use of this or a similar trade mark throughout the United States (Van Camp Sea Food Co. v. Alex B. Stewart Organization, 50 F., 2d, 976).

Accordingly, the United States Circuit Court of Appeals, in March, 1932, declined to hold that the Van Camp Company had the right to the exclusive use of "Chicken of the Sea" as a trade mark (Van Camp Sea Food Co. v. Cohn-Hopkins, 56 F., 2d, 797).

On the other hand, this same plaintiff, in September of this year, did secure an injunction (in the United States District Court, District of New Jersey) against another's "using the words Chicken of the Sea on canned tuna fish" on the ground of unfair competition. This injunction was awarded in spite of the fact that the court did not consider Chicken of the Sea "as a technical, valid, registered trade mark" (Van Camp Sea Food Co. v. Packman Bros., 4 F. Supp., 522).

It is therefore doubtful whether the trade mark "Chipso" has been materially, if at all, damaged by reason of the Patent Office cancellation thereof.

"Nevertheless," the author of the above adds, in a personal communication to the editor of this department:

"(1) Registration in the Patent Office is an absolute pre-requisite to registration in most foreign countries.

"(2) Registration does constitute *prima facie* proof of ownership of the trade mark.

"(3) Registration confers the right to sue infringers in the federal courts, regardless of the citizenship of the parties or of the amount involved.

"(4) Registration gives the right, upon filing a copy of the certificate of registration with the treasury department, to have goods bearing an infringing mark excluded from importation and made liable to seizure and confiscation.

"(5) Registration affords the possibility of having actual damages trebled, within the discretion of the court.

"(6) Registration affords the registrant the right to use with his mark the words 'Reg. U. S. Pat. Office.'"

Important Points Concerning Italian Patents

PATENTS are granted for a term of 15 years from the date of application.

Patents of addition ("attestati completivi") are granted for the unexpired term of the principal patent.

There is no provision for opposition in the present Italian law.—*Journal of the Patent Office Society.*

Patentability

"THE process of development in manufactures creates a constant demand for new appliances, which the skill of ordinary head workmen and engineers is generally adequate to devise, and which, indeed, are the natural and proper outgrowth of such development. Each step forward prepares the way for the next, and each is usually taken by spontaneous trials and attempts in a hundred different places. To grant to a single party a monopoly of every slight advance made, except where the exercise of invention somewhat above ordinary mechanical or engineering skill is distinctly shown, is unjust in principle and injurious in its consequences. The design of the patent laws is to reward those who make some substantial discovery or invention which adds to our knowledge and makes a step in advance in the useful arts. Such inventors are worthy of all favor. It was never the object of those laws to grant a monopoly for every trifling device, every shadow of a shade of an idea, which would naturally and spontaneously occur to any skilled mechanic or operator in the ordinary progress of manufactures."—*The Atlantic Works* v. *Brady*, 1883 C. D. 214, 219. (Supreme Court of the U. S.)

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NINETIETH YEAR • ORSON D. MUNN, Editor

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ACROSS THE EDITOR'S DESK

ONE point in the science of government which SCIENTIFIC AMERICAN has always approved is the maintenance of our national defenses on a par with other world powers. We are firmly convinced that adequate military forces are the surest safeguard against prolonged warfare with its consequent horrors. For this reason we are gratified at the turn which has recently been taken in naval building operations, and particularly so since we have obtained a promise from Assistant Secretary of the Navy Roosevelt that he will prepare for us a complete and authoritative article on the subject. Thus you will be able to get, from a near future issue, the inside story of the important developments that are taking place, and will have a better understanding of their vital effect on our national welfare.

●

"MENTION China to the average American citizen who has never traveled abroad, and there immediately comes to his mind a picture of a far-off, half civilized country, vaguely located 'somewhere east of Suez,' where strange and mysterious things happen; a land of quaint, picturesque cities teeming with humanity, full of queer sights and smells. . . . This is the China of the movies. . . . Get into that picture the modern steel-and-concrete 22-story structure of the Joint Savings Society of Shanghai" and, according to William S. Shipley writing in our next issue, you will have to reform many of your ideas of China. And, what is more, that modern structure is air-conditioned! Woven into the story of this building is a background of the unique economics of the Orient; century-old methods being used side-by-side with the most modern equipment.

●

IT is one thing for a person to remain afloat in the water and move his arms and legs in such a manner that he can make progress, but when he decides that he wants to swim fast enough to break records, that is quite another matter. He then finds his movements must be studied with a view toward decreasing the resistance of his body and its movements to the surrounding water. Dr. Karpovich, Professor of Physiology at Springfield College, has recently completed a study of this resistance and the factors that contribute to increasing or reducing it. His findings will interest everyone who likes to swim, and provide a number of ideas that will tend to make swimming easier and more efficient. We expect to publish Dr. Karpovich's article in next month's number.

COMING

¶ Hon. Henry L. Roosevelt, Assistant Secretary of the Navy, will write on the new and important construction policy of the United States Navy.

¶ "Working and Thinking and Eating" is an article that will reveal surprising facts regarding these three processes.

¶ William S. Shipley, an authority on air conditioning, has prepared a "different" article on the work being done in China.

¶ "How Not to Swim Faster," by Prof. Peter V. Karpovich, deals in a practical way with the physics of swimming.

●

WITH summer approaching, now would be a good time to decide that you will make a sundial to be placed as a scientifically useful ornament in your garden or lawn. There are many types of dials which may be constructed, the exact form frequently being determined by the position which the dial is to occupy. The authors of the series of articles on dials which we are publishing have reduced the directions for dial design to the simplest terms commensurate with accuracy, and have covered or will cover all of the types that the amateur would care to tackle. Articles have already appeared in the February and the present numbers; the third will be published next month. While sundials are usually regarded primarily as ornaments, don't forget that, if properly laid out, they can be depended upon as quite accurate timekeepers.

●

THE contest for higher operating speeds in the air-transport business is still being waged, with cruising speeds nearing and in some cases touching 200 miles per hour. Here is no flashing, dashing burst of speed by some dare-devil aviator straining for a new record, but a result of much thought and study by level-headed technicians and conservative business men bidding for new conquests in the world of industry. Up goes the speed and smaller shrinks the air map. What does this mean to you in terms of airmail, express, and passenger service? Reginald M. Cleveland, well known to our readers for his keen analyses of air-transport conditions, will answer this question in an article scheduled for our April issue.

●

IT sometimes happens that we announce on this page a certain article for our next issue, but that the article announced does not appear. Invariably when this occurs it is because of our desire to get into each issue articles that are timely or otherwise desirable. Since this page must of necessity be written before the next issue is made up, the information contained here is gleaned from a tentative schedule of coming articles. If, then, before the next issue is complete, some article is obtained that we feel our readers should have with the least possible delay, it becomes necessary to take out something else in order to make room for it. This is what has happened with the articles on Bug Battles, on the energy in foods, and on the refrigeration of the concrete which is being used in Boulder Dam—all of which have already been announced. They are still in hand, however, and will be presented in the near future; in fact, they are scheduled for April and unless something else of vital importance intervenes, you will find them in that issue.

Orson D. Munn

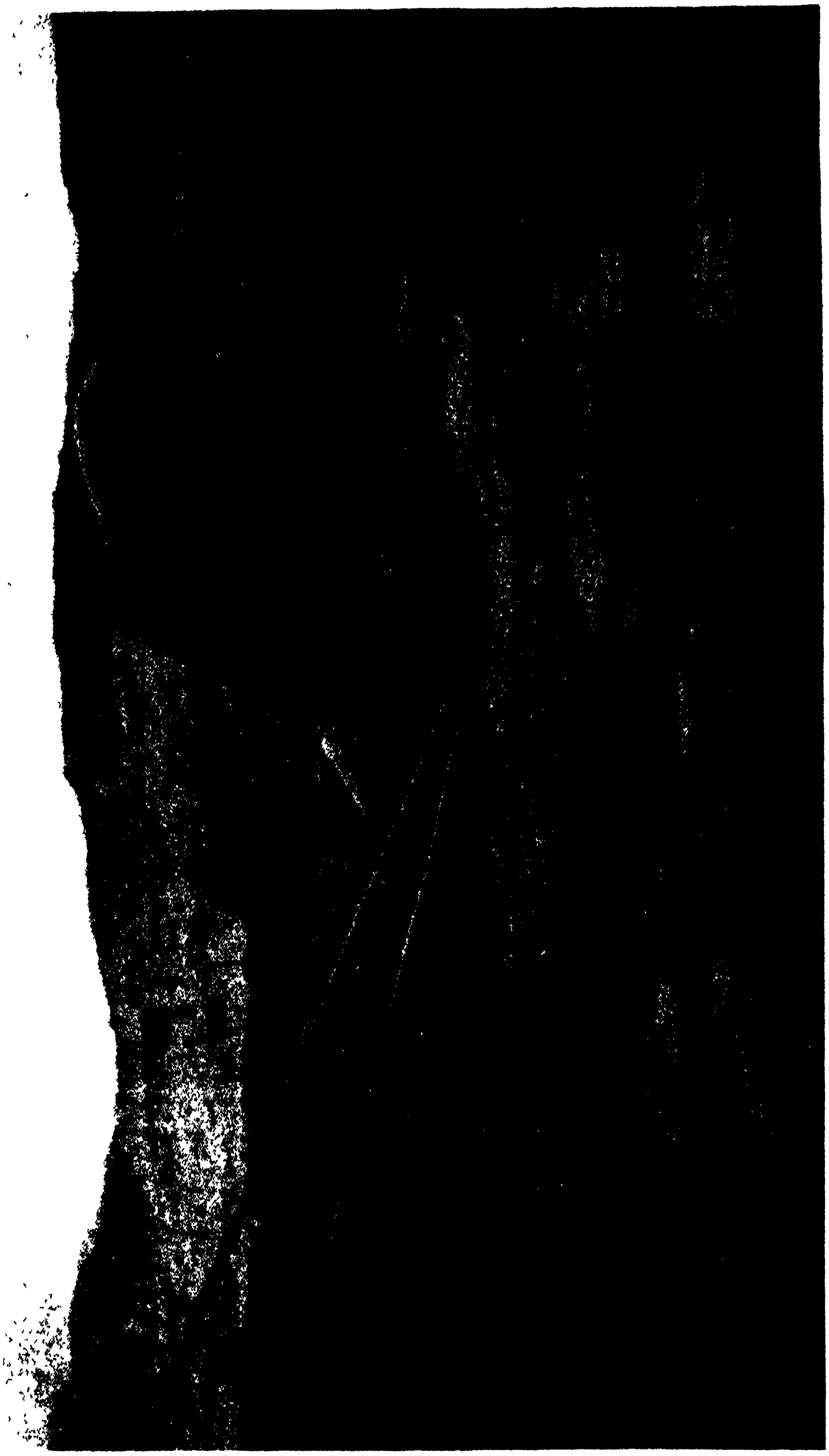
Editor and Publisher

NIKOLA TESLA

NIKOLA TESLA was born at the stroke of midnight, July 9-10th, 1856, in Smiljan, Jugoslavia. His father was a distinguished clergyman, and his mother, Georgina Mandic, came from a long line of inventors. Dr. Tesla's inventive genius was apparent from an early age; his education was received at various European universities where he studied the sciences and acquired a knowledge of a dozen languages. In 1884 he came to the United States and became a citizen in 1889. He has always, and is now, engaged in independent experimental research.

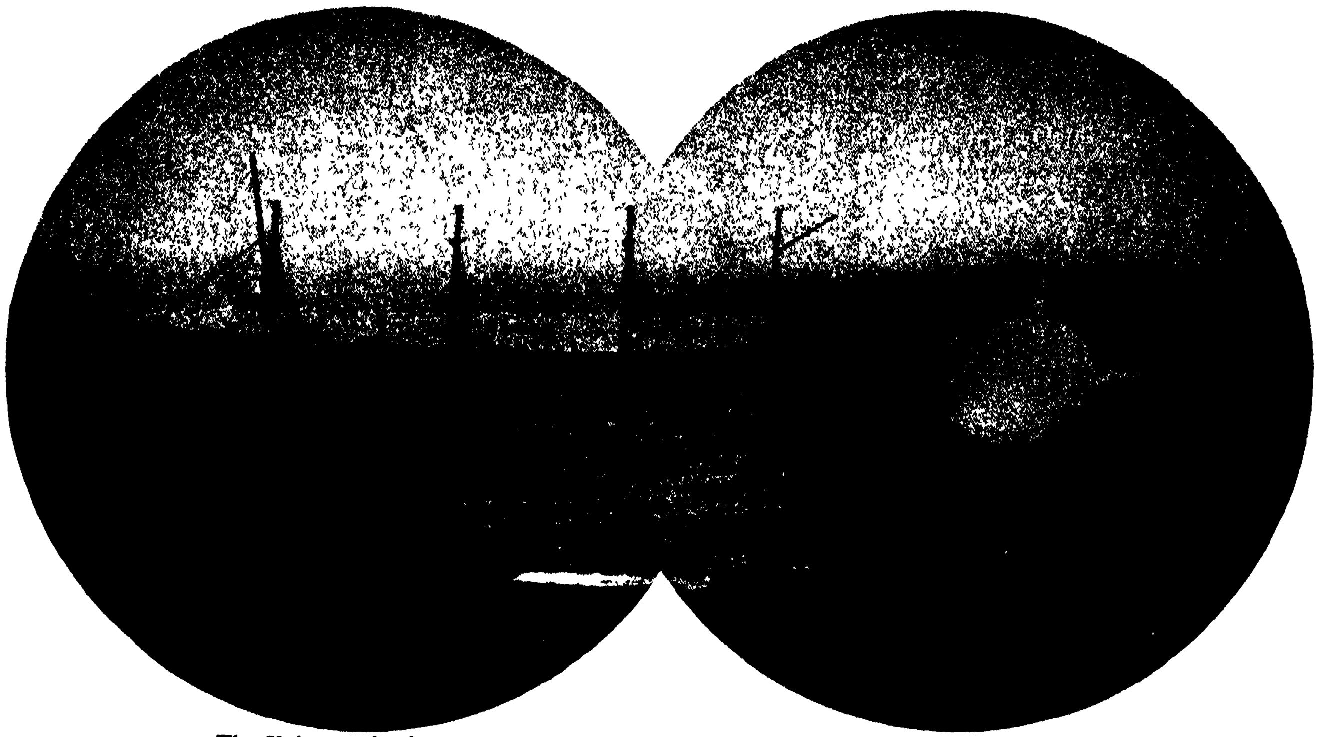
The inventions and discoveries of Dr. Tesla have been many and varied. Stated in chronological order, some of the more important ones are: The rotating field induction motor and alternating current system of power transmission, 1882-1888; Tesla coil and oscillation transformer, 1889-1892; electro-mechanical isochronous oscillators, 1890-1892; Tesla wireless system, 1891-1893; electron tubes, 1892-1893; theory of radioactivity, 1896-1898; high-potential vacuum tubes, 1896-1898; telautomatics, 1897-1899; discovery of terrestrial resonance and law of propagation of conduction currents through the globe, 1899; high-potential wireless transmitter, 1899; art of transmitting energy by stationary terrestrial waves, 1906; speedometers on new principles, means for lightning protection, types of steam and gas turbines, pressure and vacuum pumps and other apparatus, 1916-1926.

Due to unfavorable circumstances, Dr. Tesla states, some of his most important results have not yet been announced, among them being a new refining process for producing steel, copper, aluminum, and other metals at low cost.



WHERE LIFE HANGS ON A SIX-INCH NAIL

THREE Italian guides recently accomplished the hazardous feat of scaling the North Face of the highest rock of the Drei Zinnen in the Dolomites. Heretofore this climb has been considered impossible, but it was accomplished by the use of special nails and a double safety rope—a modern technique which has been found suitable for scaling overhanging precipices. Four- and six-inch nails were used, the ropes being passed through ringed heads, the climbers sometimes resting their feet on the ropes and at other times in crevices. The nails were driven into the rock as the climbers advanced.



The *Volunteer* landing on the bay near Los Angeles. Note pulling boat going alongside

Sky Boats

The "Blimp" Fills a Definite Niche in the General Scheme of Aeronautics; the Author Makes a Splendid Case for Its Versatile Accomplishments

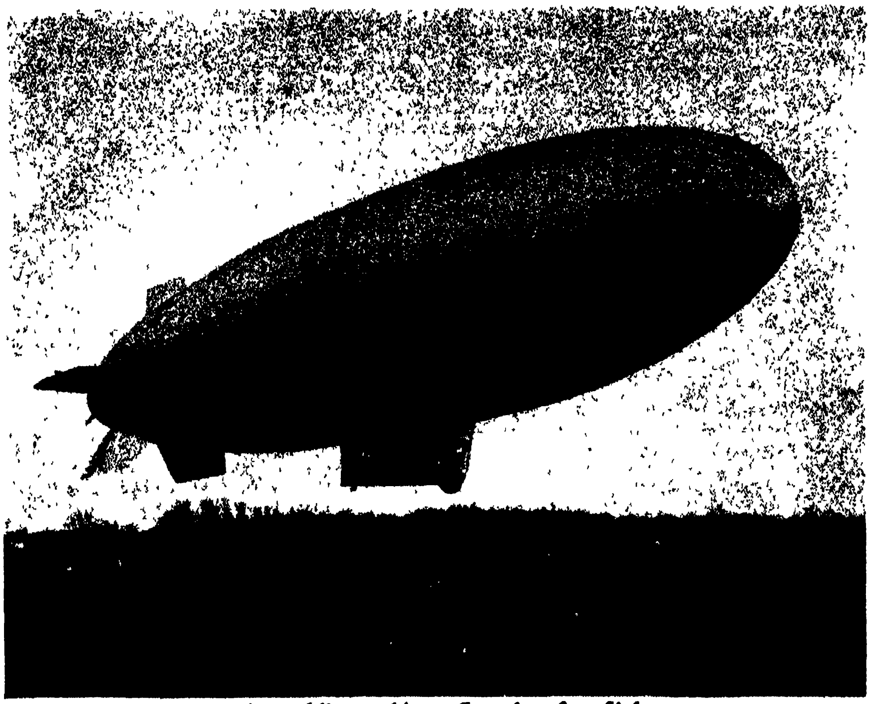
By JOHN T. ROWLAND
Late Lieutenant, U S N.R F

WHEN the steamship *Titanic* sank with an appalling loss of life after ramming an iceberg on the Grand Banks one foggy night some 20 years ago, the American public did not demand that all seagoing ships be scrapped forthwith. There *was* created in the public mind a temporary prejudice against very large steamers, and this prejudice had some foundation in fact. A similar prejudice exists today with respect to the airship, but with this important difference, that the general public is strangely unaware of what the smaller types of airships have done, are doing and can do.

This is not intended as a tacit admission that the case for the big dirigible is hopeless. How could that be when the *Graf Zeppelin* has circled the globe and has run on a mail-and-passenger service across the South Atlantic? Even away back in 1921 the Zeppelin *Bodensee* made 100 flights in 97 days between Berlin and Friedrichshafen, and carried upwards of 2300 passengers without mishap. No, the case is not hopeless, though the big dirigible appears to have certain definite limitations. However, the point of this writing is not to start a controversy on Zeppelins but rather to draw some merited attention to that extraordinary and little appreciated sky boat, the humble "blimp." We quote the word because it is really a nick-name, being a contraction of the official British Air Service designation, "B—Limp," which applied to small dirigibles that boasted no interior framework to help them "hold their shape." *Limp*, that is, as opposed to *rigid*. From official slang the word passed into the general tongue and now is applied indiscriminately to small airships of any type. It is to "Zeppelin" what "boat" is to "ship."

To the majority of our newspaper reading public, who regarded the recent loss of the Navy blimp *J-3* as just another tragic proof of the futility of airships, it may come as something of a surprise to learn that the British maintained a continual patrol of their coasts with such craft during the latter part of the World War, and that certain blimps, of a type far more antiquated than the *J-3*, went aloft *every day* in the year, with only a short period out for routine refit and overhaul, and that they kept the air in weather when the going was more than lumpy for a 300-foot destroyer at sea. This I saw with my own eyes, from the bridge of one of the latter. Once we, on the U. S. S. *Wilkes*, were intercepted and given a message by a tiny blimp with a crew of three men that came ramming out from shore on the back of a blustering Irish nor'wester. Seeing her coming, we thought she was out of control, and stood by to rescue; but when she had semaphored her message she turned about and bored back into that roaring head wind faster than we could follow under all four boilers. And *Wilkes* was a destroyer, bear in mind.

ONCE again I must qualify a statement. This sounds pretty much like a knock at our own Navy fliers. It is nothing of the sort. A de-commissioned ship, gotten ready in the haste of emergency and taken aloft under storm conditions by a scratch crew (however able they might be as individuals) is in no condition to offer a fair test. The resultant disaster proved as misleading as the act itself was heroic—for be assured that those men in the *J-3* knew the risk they were running and took it only in the hope of saving some of their comrades who had been reported clinging to the wreckage of the *Akron*. It



An Army blimp taking off on her first flight

seems a pity that the pressmen did not grasp this essential fact.

It may be our extraordinary preoccupation, as a people, with mere bigness which has caused American eyes to be focused on the monsters of the sky while overlooking the capabilities of the pygmies. Personally, I must confess to the diametrically opposite type of mind. As an amateur explorer, it has always given me a peculiar satisfaction to undertake with a very small boat and meager equipment what others have felt required a million-dollar outfit; and I am, I believe, one of the three or four persons living to have navigated a 30-foot sailboat to the Arctic. This is not written in boast but rather as a necessary foreword to what is coming, if my opinion is to carry any weight.

In civil life and even in the Navy itself I have been singularly impressed by the importance which we too often attach to mere size, as, for example, by assuming the command of a battleship to be more important than that of a destroyer, when, as a matter of fact, the destroyer's duties may be the more important and may call for a higher degree of leadership and technical skill. The same comparison (I believe) holds true as between Zeppelin and blimp, though not necessarily in a military sense. Let us see what are some of the remarkable feats at which the little sky boat excels.

Coming back to the wartime blimps —since they had certainly the severest test of any—it is interesting to discover that on a particularly stormy section of the British coast there were *only 8 days without airship patrol* between January and November, 1918. The sky boats making these patrols were mostly little three-man blimps of the famed British Coastal class. Their envelopes looked like over-stuffed sausages—the same shape at bow and stern—and their control cars consisted of a long and narrow boat-shaped affair suspended some distance below the bag, with a motor and prop at each end. They were officially credited with a maximum speed of 40 knots. Yet one of these little "rubber cows" remained in continuous service for 805 days, during which she was in the air approximately 2500 hours, or an average of 3 hours and 6 minutes per day. And yet people say that blimps are toys. Perhaps the very smallness and handiness of these little Coastal jobs—they could shelter in a copse of wood—was what gave them success.

To return to America: I was talking not long ago with a student pilot in one of the Goodyear company's blimps—the sort we are accustomed to see towing an advertising banner over Los Angeles or New York—and he told me the following yarn. He and the pilot were returning to the coast from a "voyage" to some city in Texas or New Mexico when they encountered an unexpected easterly gale. This was a tail wind for them and would have been very fine had it not been for the great mountain barrier of the Sierras which lay across their course not many hundreds of miles ahead. They did not like to think of barging in upon those ragged mountain peaks after dark without perhaps being able to gain altitude enough to cross them safely. Accordingly, they turned her head to wind and ran the twin motors wide open in an attempt to win back to "harbor"—a town with an airport where they might moor and ride out the gale.

But after an hour or so of snail-like progress the little ship began going backwards over the land. This was not so good, since she was getting nowhere and her supply of fuel was low. The country beneath her was mostly desert, with an occasional small town nestling beside the railroad tracks. Each hour the blimp's speed backwards increased as the gale steadily mounted. She could cut across it, like a boat in a swift current, but buck it she could not. And out on the great desert there was no port of refuge under her lee.

Now it happens that every one of those desert hamlets has a great water tower rising out of its midst. Maneuvering the blimp like a powerboat, the pilot managed to work the bight of a mooring line round one of these towers. As the ship eased back he paid out line until she fetched up on the bitter-end (which was a nautical term long before it came into literary use) and the mooring line gradually took over the strain from the motors. There she lay, moored to a water tower, for all the world like a powerboat fast to a buoy, while the gale blew itself out. The irony of the situation was that, so close to water, her crew suffered acutely from thirst, as they could not get to the ground and the blow lasted more than three days.

A plane would have been obliged to land and risk cracking up and a big airship would have had no choice but to hurdle the Sierras—unless, of course, she could have run south into Mexico far enough to get out of the storm.

Cross country blimping is not all beer and skittles even in good weather. The big gas bag offers an apparently irresistible target to farmer lads who have never "drawn a bead" on anything larger than a squirrel. No one has been killed to date, but there have been some miraculous escapes and much valuable helium gas has been expended. A curious mental squirk, this; and a most uncomfortable one for the victims. It may be due to the blimp's proclivity to stray off the beaten track and fly over backwoods country where aircraft of any kind are rarely seen. The ability to do this is one of the great advantages that sky boats enjoy over the plane, which is obliged for safety's sake to follow established routes where there is always an emergency field handy to glide to in case of trouble.

The blimp, on the contrary, does not stay aloft merely by the grace of God and a speeding motor; she floats in the atmosphere as a fish does in the sea. She can shut off her engines entirely and drift as a free balloon—which must be a delightful way to travel with a fair wind.

Three Typical American Blimps

Name	*Year*	*Length (feet)*	*Power*	*Number of Passengers*	*Capacity of Envelope (cubic feet)*
Pilgrim	1925	110	1— 60 h.p.	2	56,000
Volunteer	1929	133	2— 80 h.p.	4	96,000
Defender	1929	184	2—165 h.p.	8	183,000

Compared with British Coastal Class Used in War-Time Patrol

Name	*Year*	*Length (feet)*	*Power*	*Useful Lift*	*Capacity of Envelope (cubic feet)*
Coastal	1915-'16	196	1—110 h.p. 1—220 h.p.	0.9 ton	170,000

The maximum speed of the British Coastal class was 40–45 miles per hour, that of the larger American blimps is as high as 80. The British ships were inflated with hydrogen, whereas helium gas is used in American blimps. Its cost for commercial use is about 85 dollars per thousand cubic feet.

Since 1925 the Goodyear fleet has carried, in round numbers, one hundred thousand passengers, and covered a million and a half miles round and about the United States. A small blimp, which is able to carry three or four passengers, is some 130 feet long overall and has a cruising speed of 45 miles per hour with twin motors consuming gasoline at a rate of 11 gallons an hour. This means but four miles to the gallon, air speed. It appears therefore not to be an economical means of transport.

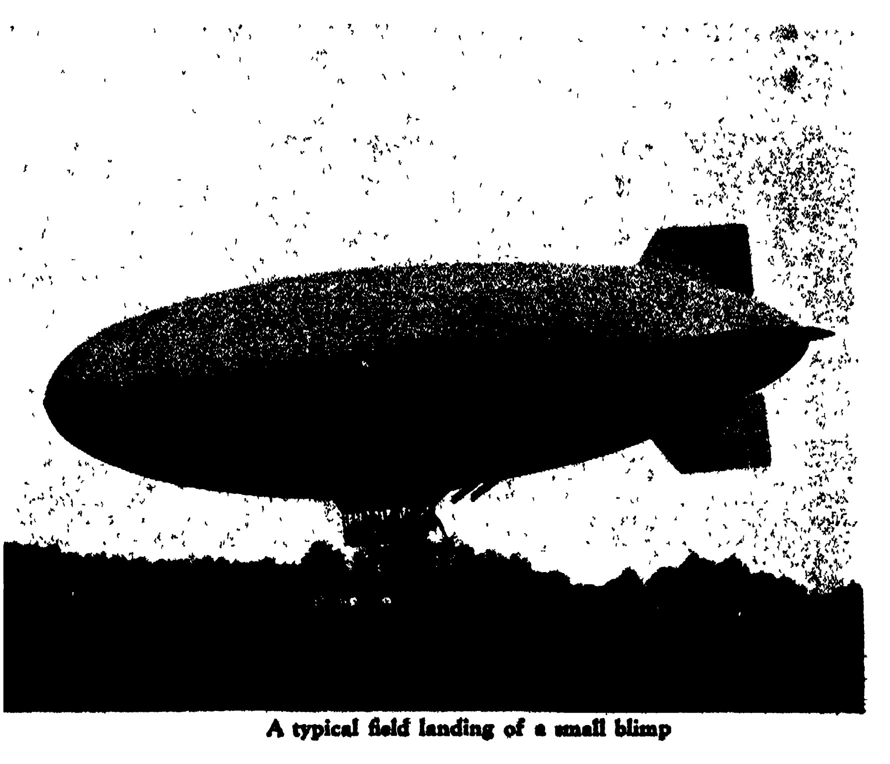
No doubt in actual mileage that is the case, but the blimp can do things no plane could dream of, as, for example, coming down in the Florida Everglades and taking on board a marooned aviator whose plane had crashed in the swamp. This man might never have gotten out otherwise, since the character of the country was such that he could neither walk nor swim, nor could boat, plane, man or horse get near him. The blimp in this case never actually touched; it nosed down slowly and came to rest in the air a few feet off the ground, and the marooned man was drawn up to it. In another case a flyer who crashed in Biscayne Bay and swam to a small island covered with scrub was discovered by one of our Navy blimps, which came to rest over the spot and lowered a rope ladder, up which the rescued man climbed.

It is for work that involves hovering motionless or drifting slowly with an air current that the blimp's peculiar qualities are best suited. This includes observation of various types, map-making and photography. This is so obvious that it does not require elaboration, but it recalls the story of some chaps I knew aboard a subchaser who came upon a British Coastal blimp apparently down at sea. On running up close they found her to be lying a few feet off the surface with a couple of buckets for sea anchors, while her crew of two took advantage of a rare spell of fine Irish weather to do a little fishing. It used also to be said that British blimps would sometimes hover over an American ship and lower a bottle of wine on the end of a string in exchange for a carton of cigarettes, but for this breach of regulations I will not vouch. It could easily be done. Blimps have landed on the decks of ocean steamers with no more ado than bringing a powerboat up to a float. This matter of landing is perhaps even more vital than the ability to hover motionless *en plein air*.

To summarize, blimps have been used (1) to rescue persons from terrain on which no sort of airplane could possibly land, not only in mountainous country but also in forests and in swamps; (2) to land passengers on the roofs of skyscrapers, in small city parks (such as the Battery in New York) and on the decks of ships; (3) to set down scientific workers and their equipment on mountain ranges and go back and pick them up when their work was done; (4) to remain for hours aloft watching for forest fires, with little expenditure of fuel; (5) to operate on regular passenger runs without the need for special landing fields at every stop; and, finally, (6) as already cited, for observation patrol in time of war.

If this little craft has such exceptional powers why has its use not been more eagerly sought? The answer is probably that it lacks three qualities which are today all important in commercial flying, viz.: (1) reasonable cost, (2) high speed, and (3) carrying power. Three passengers is all the load a blimp will carry that costs perhaps as much as a twelve-passenger plane and goes only half as fast. What more need be said? Only this: If and when the present high cost of manufacturing and sewing those wonderfully light, thin, strong, and tight fabrics that form the envelope of the blimp is reduced—fabrics three layers of which are but one-thirty-second of an inch in thickness and yet which sustain the weight of the car by "finger-patches" and permit a gas leakage so slight it can scarcely be measured—if and when, I say, the cost of this fabric is lessened so that the blimp can compete on a dollar basis with motor cars and boats, many of its interesting features will suddenly be "discovered."

For example, there is a certain spot in the western portion of these United States that can be reached only by air, since it is girt about by whole series of precipitous cliffs thousands of feet in height. At the bottom of the deep canyons between those cliffs no other air-craft could find a place to land. No man, so far as I know, has set foot there yet. I hope to some day—from a blimp. But I am pretty certain that the blimp will not be mine!

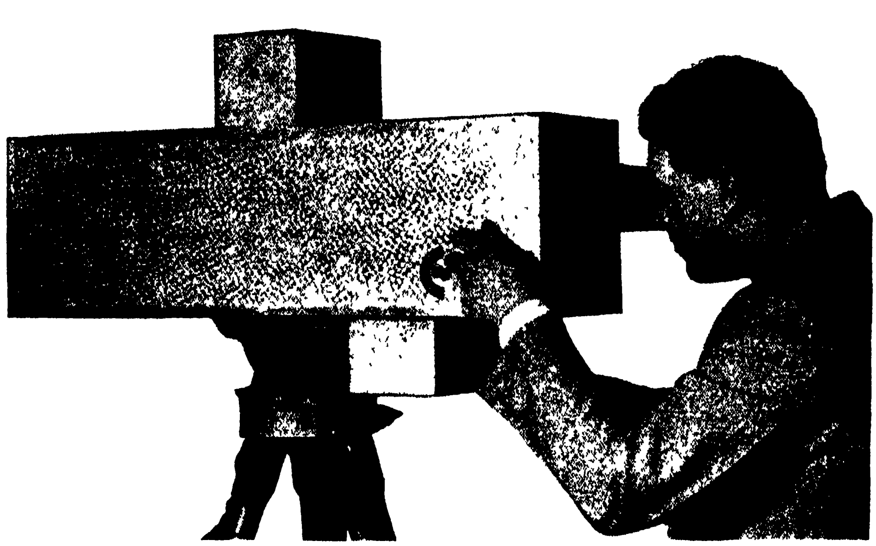


A typical field landing of a small blimp

Infra-Red Rays Dispel Fog Dangers With New

QUICK-ACTION NAVIGATING CAMERA

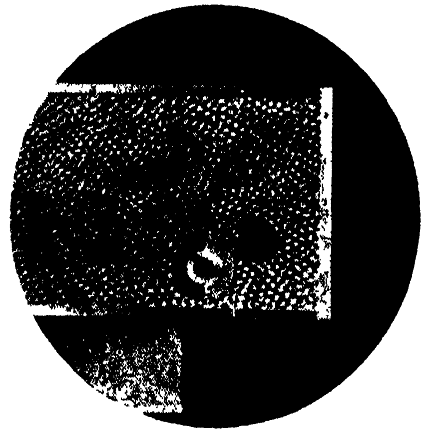
A HINT of the new development in navigating equipment described here was given on our editorial page in the January issue. At that time the following statement was made: "... it is understood that the operators of the United States Lines are now working on a new development, explained to us in confidence, which will assure safer navigation in dense fogs than has ever before been possible." Now the story can be told. The device explained to us during an inspection of the S. S. *Manhattan* was the Fog Navigating Camera invented by Captain Flavel M. Williams, which has been given thorough and conclusive tests in actual service and has been found to constitute an outstanding achievement in man's battle against fog.



Captain Flavel M. Williams with his fog-piercing camera

Briefly, the camera is a combination, in one compact housing, of a lens and shutter arrangement, a holder for infrared sensitive film, and a developing and fixing compartment. By the use of special film produced by the Eastman Kodak Company of Rochester, New York, and developing solutions adapted to the purpose, the operator can make an exposure and within a few seconds he can view the developed film.

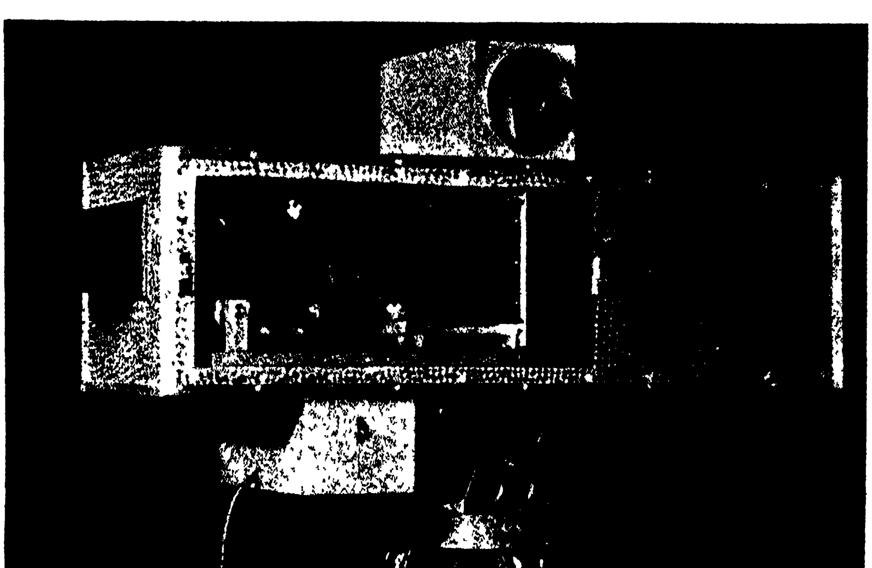
With this camera mounted on the bridge of a vessel, exposures can be made at intervals governed by conditions at the time, and the vessel can proceed through haze and dense fog that ordinarily would mean greatly reduced speed or even the necessity of dropping anchor and awaiting clear weather. Repeated tests have shown that when the visibility to the naked eye was only 400 feet, negatives taken with the camera revealed objects ¼ of a mile and more away. It is well known that infra-red rays, to which the eye is insensitive, are able to penetrate fog to much greater distances than visible light. (A chart showing the place of infra-red in the spectrum is reproduced on page 139 of this issue.—*Editor.*) These rays can be used to affect a specially sensitized film and to make a record that does not differ materially from that made by visible light on the ordinary photographic film exposed in the usual manner.



The film operating knob and indicating dial on the side of camera

THE illustrations on this page show the construction of the camera. The lens is in the forward part, shielded by the housing from rain and snow. Immediately behind the lens is a pressure plate through which is fed the eight-inch-wide infra-red sensitive film. After the exposure is made, the operator turns a knob on the side of the housing, winding the film into the developing bath, after which it is fixed in another tank and viewed in a mirror while still wet. The entire time required, from making the exposure to seeing the image on the film is less than 30 seconds. This can be further reduced by refinements in emulsion and developer.

A scale at the pressure plate, which is photographed directly on the film at each exposure, and another scale on the tripod of the camera, enable the navigator to fix the exact positions of distant objects relative to the heading of his vessel.



Photographs courtesy The New York Times Studio

Side plates of the camera removed to show, in the upper compartment, the storage reel for film, and the pressure plate, chemical tanks, and viewing mirror

OUR POINT OF VIEW

What Ails Railway Service?

JOSEPH B. EASTMAN, the Federal Coordinator of Transportation, wishes to discover ways by which passenger service in this country can be improved, and has issued thousands of ballots on which passengers on the railroads can express their opinions of existing service and suggest changes.

One thing our railroads need is the redesign of passenger coaches by someone who is not a railroad man and who will not be influenced by any sacred traditions of railroading. Just as the early motor car was an evolution from the horse-drawn vehicle, so were our passenger coaches an evolution from the old-fashioned horse-drawn coach. It took the motor industry a full generation to abandon all of the sacred traditions of this ancestor of the motor car, while the railroads still cling to the descendent of the old coach. Like Topsy, our railway cars "just grew"—with the exception of two recent innovations—compartment cars with beds, and air conditioning.

Again, take dining car service: Why are meals on board train so expensive? Because the maintenance of this service is so wasteful—wasteful mainly because of the wide variety of food which must be carried and offered and largely thrown away in the end. In Great Britain an attendant passes through the train and hands out tickets for "sittings." Later, at a call, all the holders of a given sitting ticket repair at one time to the dining car. There are two choices of entrées—enough to suit all except the epicure and a few constitutional objectors. Meals are served by courses to all at the same time. The savings in food and labor thus made possible enable the British people to dine on their trains at a reasonable cost. Such a service is not quite so resplendent as the one we have, but ask the objector whether it is not likely to be quite as good as he has at home (where most of us take just what is served and "like it").

The inquiring Federal Coordinator asks the people's opinions regarding accelerated train speeds. Just now the air is full of easy talk about 100-, 110- and 120-mile speeds. Train speeds can be accelerated but in our opinion, before it has been learned that there is a maximum safe speed, the public will have hounded the railroads into putting on very fast trains which are destined one by one to be wrecked. It is hoped that the railroads will not allow thoughtless speed maniacs to stampede them too far.

Industrial Pensioners

THERE is one important industrial problem—or should we say sociological problem of industry—on which no one seems to have put much thought. This is the problem of the retired employe. What is to be done for this man who has filled a job with one company for 35 or 40 or 50 years and is retired on a pension? He gets his retirement pay, it is true, but is that enough? The record of such men shows that, once he is taken off his life-long bench or lathe or desk, the retired man wanders in a sort of daze, lost in a strange life of leisure, and rapidly loses interest in life and often dies quickly.

This question was recently brought to our attention by a remark made by an executive of one of the country's largest manufacturing concerns. He expressed his sympathy for these "old fellows loafing on street corners." This started a train of thought from which the following plan evolved:

To provide the work-interest for these older men to whom work is a habit not easily broken without serious psychological consequences, suppose such firms as Westinghouse, General Electric, Eastman Kodak, and the like, each set aside a small building to be used by the pensioners exclusively as a shop-laboratory. In this building let there be installed small lathes, work benches, tools, chemical equipment; and let the pensioners be told to make themselves at home, to build whatever they please, to work on inventions, to play at hobbies. A paid superintendent, to keep them peaceful and happy, might also be an instructor in hobbies such as the making of machinery models, wooden objects, telescopes, or delicate scientific instruments. There is no doubt that the small cost of carrying this building and this equipment would be repaid manyfold not only in the happiness of the pensioners but also in that it would open up a pleasing prospect for those nearing the retirement age. Last but not least, actual dividends might accrue to the company in the form of worth-while inventions or discoveries which might emanate from these men with a lifetime of training behind them.

This is our plan in brief; details could easily be worked out to provide for all contingencies. We would welcome the comments of industrialists concerning our plan and would be glad to assist in working out further details.

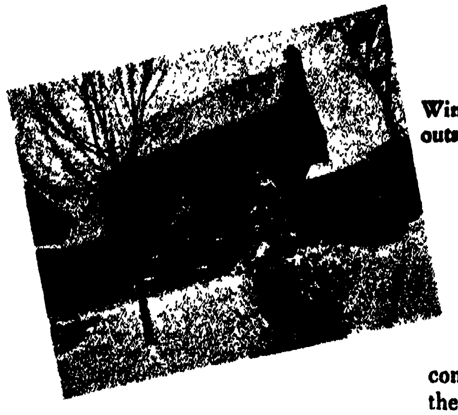
For Fathers Only

SOME months ago W. F. Bond, the Mississippi State Superintendent of Education, sent a questionnaire to three groups concerned with the upbringing of the youth—state superintendents and commissioners of education, college students, and high school students. He asked each group to name the three most deadly enemies of the youth today. *School Life*, a magazine published by the United States Department of the Interior, Office of Education, reports his findings, which are that idleness and lack of responsibility, strong drink, and improper relations between the sexes are the three culprits; to which moving pictures of the wrong kind was added as a fourth. The expression of opinion among high school and college students did not differ essentially from that among state superintendents. These being the findings, Mr. Bond asks: What shall we do about it?

In the first place, what *can* we do about it—what can we ever expect to do about it? In some fields, medicine for example, diagnosing is often more difficult than curing. Here the diagnosis is relatively easy but the cure eludes us. So far as is known, there is no patent method of curing these deadly enemies of the youth, for their cure depends upon the provision of one prerequisite, unfortunately a difficult one to attain: the building of character.

In such circumstances, what direction, beyond those conscientious attempts to build character which are assumed on the part of all qualified parents, can the average practical parent's efforts take? How should a father instruct his son regarding strong drink, sex relations, gambling, and so on? Should he go on the assumption that *his* boy will always be a nice boy and therefore counsel him only to be a nice boy, or should the father assume frankly that the young boy is the old boy's son—that he will probably get into as much deviltry as dad did, and therefore attempt to forefend against the worst of its damage by instruction which is really practical if nothing else?

Among our readers there are known to be many fathers of growing boys. Would they like a series of articles containing instruction of that practical kind?



Winter at the laboratory-home: cold outside, balmy "springtime" within

SPRINGTIME

By J. W. HAMMOND

THROUGH many recent generations sentiment and science have combined to enhance the home. In the material improvements which it repeatedly has produced and promoted, science undoubtedly has made the home more livable. It has thus buttressed the powerful but intangible influence of sentiment; and sentiment, in this restless age, might find itself under great disadvantage if compelled to work single-handed.

Yet many persons will contend that various achievements of applied science have a tendency to undermine to a surprising extent the natural home-loving instincts of American families. People today spend far more time "on the move" than did folk of two generations ago. Many factors lure them from their homes in almost every season of the year, particularly during the long, pleasant stretch of outdoor weather from early spring to late autumn.

Suppose, however, one were more comfortable at home than awheel. Suppose the hot muggy evening were confined to the out-of-doors and that the indoors atmosphere were delightfully refreshing, even exhilarating, both to body and mind. Regardless of extraneous attractions none would then think of leaving home. Literally man's domestic abode would be something akin to an oasis in a desert. "Home, sweet home" thereby would become sweeter than ever; it would be transformed into a veritable garden of Eden by air conditioning.

"OUR definite objective," says Elliot Harrington, air-conditioning engineer of the General Electric Company, "is completely to reproduce indoors the conditions of a balmy, sunny spring morning in the open country immediately after the air has been washed clean by a shower of rain. We seek to maintain these conditions throughout the year."

More logically, perhaps, than most engineers who are working in this field can Mr. Harrington talk for publication about the "Edenizing" of homes, for his own residence in Schenectady is the official air-conditioning proving home of the General Electric Company.

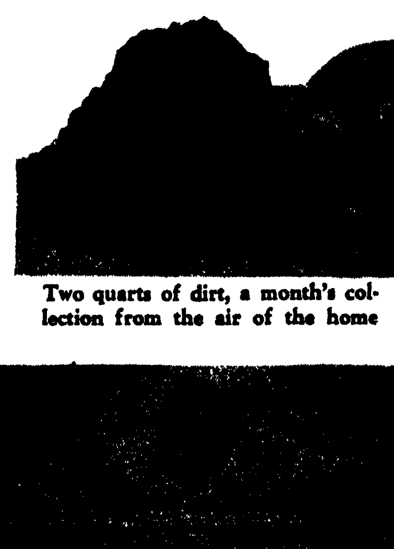
The Harrington home has become the scene of continuous tests in the frontier zone of air-conditioning knowledge. It contains far more equipment than any home that might purchase a standard air-conditioning installation. In this ten-room dwelling there is done all that present conventional practice requires—and a great deal more. The four factors of temperature, humidity, circulation, and purity, which constitute air conditioning as thus far understood, and which in themselves will impart great comfort and health to inhabited interiors, are here efficiently applied throughout the entire house by a central air-conditioning plant located in the basement and operating through a system of ducts.

MR. Harrington and his associates have devised a scheme of recording electrically, by means of thermocouples, the temperature at a hundred places throughout the house, in every room, in different areas of each room, and at different levels between ceiling and floor. These temperatures are received and tabulated in an instrument room in the basement. The records so obtained have revealed that, lacking forced air circulation, a person standing erect may be in a temperature of 70 degrees Fahrenheit at the breathing line while a child playing on the floor at his feet is in a temperature of about 62 degrees, and at the ceiling just above his head the temperature is close to 80. This is a differential between floor and ceiling of about 18 degrees. With forced air circulation, such as obtains under air conditioning, this differential is reduced to three or four degrees—70 at the breathing line, 68 to 69 at the floor, and 71 to 72 at the ceiling.

Although air conditioning essentially embraces heating and humidifying in the winter, as well as cooling and dehumidifying in the summer (with air circulation and air cleansing, or filtering, the year 'round) at the Schenectady proving home a somewhat closer analysis was directed toward the cooling problem. Here a calculation was arrived at disclosing the various factors contributing to the cooling load. This showed the following:

Conduction through walls and windows, 15,300 Btu. per hour; five persons (400 Btu. per hour per person), 2000; ventilation and dehumidification, 12,600; conduction from attic, where heat accumulates from solar radiation, 10,200; solar radiation on walls and through unshaded windows, 26,100; total, 66,200 Btu. Cooking was disregarded because the kitchen is ventilated but not cooled. The load as shown was based upon outdoor conditions of 91 degrees, Fahrenheit, with 45 percent relative humidity, and indoor conditions of 78 degrees with 45 percent relative humidity, with slightly more than one air change per hour.

Several possible methods of reducing the cooling load were revealed. Awnings over windows exposed to the sun cut down the load by 11,000 Btu. per



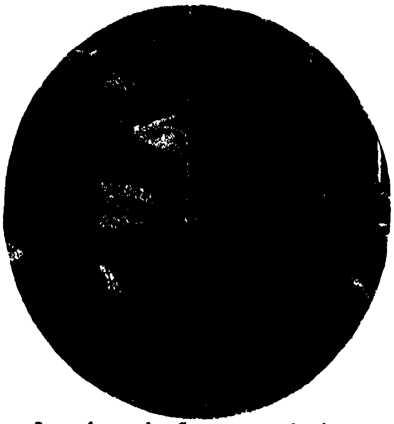
Two quarts of dirt, a month's collection from the air of the home

A few of the instruments in the General Electric air-conditioning proving home basement

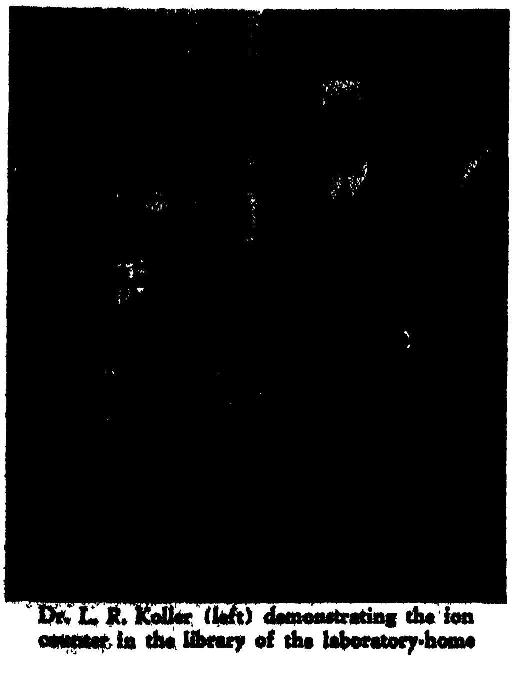
IN THE HOME

hour. Outdoor air circulated through the attic by a fan, preventing the accumulation of heat from solar radiation, produced a further reduction of 10,200 Btu. per hour. It was estimated that a layer of insulating material in the walls of the house would have made possible a reduction of 9000 Btu. per hour, giving a total cooling load of only 36,000 Btu. per hour. From this phase of the study it was clearly indicated that the type of house construction has a direct bearing upon the cost of air conditioning. Much may be done, at the time a house is built, to reduce the necessary size of the equipment, and hence both the cost of installation and operation.

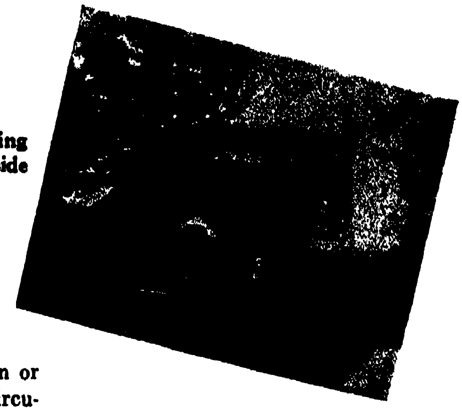
As it is, the proving home possesses no structural provisions for air conditioning, except a half-inch layer of Celotex on the lower side of the roof rafters, and storm sash at all windows.



Just above the floor: one of a hundred thermocouples that are used



Dr. L. R. Koller (left) demonstrating the ion counter in the library of the laboratory-home



Sultry sun outside; air conditioning and spring-like conditions inside

All the rooms are provided with the following equipment, most of it especially installed for testing only:

Heating by either steam radiation or circulated warm air; cooling by circulated cool air with (a) indirect expansion system to facilitate cooling measurements and (b) storage cooling for special testing; air cleaning by means of oil-treated steel wool filters; humidification in winter and dehumidification in summer. A two-pipe steam system is installed in the sun porch only, with separate automatic temperature control for special study. Forced ventilation to out-doors is employed in the kitchen, and in kitchen and baths steam heat alone is supplied, without air conditioning, so that odors will not be carried through the house. The air-duct system of the house has supply and return ducts at various locations in both floors and walls, permitting an intensive study of the various forms of air distribution.

THE operating performance of the equipment is indicated by the following summary: Humidity control—(winter) adds maximum of 1½ gallons of water to the air per hour; (summer) withdraws water from the air at same maximum rate; filters—remove 90 percent of the dust particles larger than 10 microns, and 35 percent of particles 10 microns or smaller; air distribution—1600 cubic feet per minute; heating—130,000 Btu. per hour; cooling—45,000 Btu. per hour.

Certain aspects of both the normal and experimental operations going on at this home are a distinct revelation to the housekeeper, who in this case is Mr. Harrington's mother, Mrs. Grant D. Harrington. When she was shown two quarts of dirt which had been filtered from the air of the house in a month's time she was greatly astonished, and her first thought was that the neighbors would regard her as a slack housekeeper if they heard about it. But it was explained to her that this was dirt which was removed from the air before it had a chance to settle; and before long she was willing to concede that never before had she presided over such a super-clean domicile.

There are some forms of unique developmental work going on at this home which are far different from the elaborate tests that are being performed with existing equipment and methods. A study of ionization and its effects upon occupants of the home is one of these. An instrument developed in the General Electric research laboratory which measures and records the number of ions (electrified particles) per cubic centimeter in the air of a room is on duty in the library of the proving home. Already it is well known that the number of ions decreases rapidly when human beings are in the room; also that the proportion of ions in the outdoors air is very high on clear, sunny days and lower on cloudy days.

THERE is thought to be some unknown factor involved in ionization which may be of benefit to human health and comfort. It is conceivably a subject for the medical profession to investigate, but meanwhile a careful record is being kept at the proving home of the accumulating data.

It is Mr. Harrington's belief that other elements, perhaps of a psychological nature, may also be lacking. Excellent though it is already, with temperature and humidity control, circulation and filtering, air conditioning still falls somewhat short of that balmy spring morning in the open country just after a shower. Perhaps the smell of earth and grass, the singing of birds, the vistas of landscape and sky may be necessary.

In completely air-conditioned homes of the future, Eden will be at least approximated, and the people living therein will be as much blessed by idyllic atmosphere as were Adam and Eve themselves. It will probably be extremely doubtful if folk will then hanker to leave their dwellings in search of comfort and diversion. Concededly there are various elements in modern life which have rather pulled the American home apart; perhaps air conditioning—"Edenizing," if you please—will cement it together again.

Babies by Scientific Selection

By JOHN HARVEY CALDWELL

BABIES of extra-marital paternity are now being born of women who have sterile husbands, by artificial insemination with the life-giving germ from selected men. This is one of the most significant eugenic developments in the history of man.

Philosophers from ancient times have advocated the breeding of better offspring from selected types of persons for racial improvement. But any such suggestions for the betterment of man have always met with the greatest of disapproval. Nevertheless, science has made artificial conception possible and many of the present generation of married women—those who have sterile husbands—as a matter of expediency are having children by this alternative, using the sperm of some man selected for his hereditary qualities.

As one interested in certain aspects of social trends, I have been making an investigation of this phenomenon, in order that its effects on these trends may be determined. In order to obtain an estimate of the extent to which children of such selections are being born, I called upon 200 physicians and made inquiry about it.

Most of the physicians were specialists. Eighty-four are listed in "American Physicians and Surgeons," edited by Fifield. Several of them had a national reputation for their knowledge of sterility and its treatment.

The physicians were located as follows: Chicago, 45; Milwaukee, 15; Cleveland, 15; Washington, 20; Philadelphia, 25; Newark, 7; Brooklyn, 10; and New York, 63.

FIFTY-SIX of the 200 physicians interviewed had received a total of 275 to 300 requests from patients for artificial inseminations with good sperm from a selected source, because their husbands were sterile. Fifteen of the 200 physicians did not commit themselves as to whether or not they had received such requests. Most of these 15 doctors were "not interested," or else they objected to this practice. One hundred and twenty-nine of the physicians said they had never received such requests. Several of these physicians stated that they had had patients who wanted to talk about this matter, but they discouraged it because they did not think the public was ready to sanction it.

The 56 physicians who received requests for artificial insemination reported their experiences as follows:

THE accompanying article deals with an essentially new scientific practice—the artificial impregnation, performed by a physician, of would-be mothers whose husbands are sterile, using semen obtained from a eugenically selected donor.

As practically no organized information regarding the present extent of this practice has been available, the author has attempted to gather some, but exact statistics are of course not available at present.

The practice of artificial impregnation is not a widespread one and, though growing, it is unlikely ever to become large. What are its moral and legal aspects? Mainly it is thought by some to be not a moral question but more a matter of sentiment—to be decided in each case by the individual concerned. No social menace seems to be involved, and it is not illegal so far as is known. However, some interesting legal tangles with regard to the status of the resulting offspring may be involved.

Opinions with regard to artificial impregnation will differ widely, and no doubt strenuously. Later it is hoped that a selection of short, concise letters inspired by this article can be published, in order that a sort of "forum" with regard to this little-discussed subject may for the first time be made available. Most of the readers of this magazine are men, but letters from women are especially solicited. Male readers should remember that, in final analysis, women will control the fate of this question, and that their point of view may differ from that of the average man.

—The Editor.

Nine of these physicians said that they had used artificial insemination, with sperm other than that of the husbands, for conception in the case of 25 patients, with successful births. (A few of these doctors did not state exactly how many of these conceptions they had charge of, but there were at least 25.)

Five stated that they were doing some of this work, but did not mention whether or not any conceptions had resulted. One, a woman physician, stated that she now has three patients who wish babies from selected sperm, but that she does not like to take the responsibility for it.

Four had tried a few artificial impregnations but had had no results.

Fifteen did not state what they did with regard to the patients making these requests. However, several of them spoke favorably of this method.

Twenty-two turned applicants away for various reasons such as: Not wishing to risk being brought into court; afraid the husband might later change his mind; the patient did not have her husband's consent; or, because they thought the public was not ready to sanction it. Most of these physicians, however, had no particular objection to the practice as such.

Most of these requests have come in the last 10 years, particularly in the last three or four years. In the last year or two, the 56 physicians who reported favorably had received a total of more than 40 requests per year.

Some of the physicians stated that most of these requests came from the wife. An equal number said that most of the requests came from the husband as a result of the wife's suggestion. Others said that they came from both.

THE total number of requests for donated sperm in the United States cannot be closely estimated, but the data at hand are sufficient to indicate that the total of these requests must lie between 1000 and 3000 per year.

The total number of births from insemination with donated sperm can be only roughly estimated. There were 25 births out of 275 to 300 requests (most of the requests having been turned away), a ratio of about one birth to 12 requests. This ratio is probably a little too high for an average. While in this investigation there were enough random selections to provide a basis for an estimate on the total country-wide requests, there were not sufficient random selections to strike an average of the physicians who arranged these births. Therefore a ratio of one to 15 or 20 would probably be nearer the conservatively high average. On this basis, some 50 to 150 babies may be born per year from artificial conception with donated sperm.

The significant aspect of this whole matter is not the number of births at

present, but the number of requests for selected sperm, and particularly the extent this practice is likely to reach after it becomes more generally understood.

This recent development in human events has come about in a most natural and orderly manner. Not all women in this age of learning are content to forfeit their natural right to motherhood and their unborn loved ones through no fault of their own.

So accustomed are we of this generation to seek scientific solutions of all our problems and the perplexities of life, that it seems only natural for physicians, occasionally, to receive requests for artificial insemination with good sperm in unions where the wife is apparently fertile and the husband cannot be brought to a state of fecundity by treatment. Particularly is this true in unions where the physician tries artificial insemination with the husband's sperm and finally concludes that it will not fertilize.

Our increasing sterility is becoming a vital problem. Due to the effects of civilization we are becoming biologically weaker and, as in all the great civilizations which have existed before, sterility is increasing. Not only is there an increasing number of childless unions but there is also an increase in limited sterility or "one-child" sterility. Most one-child families, gynecologists claim, are not one child by choice but for biological reasons. In some cases this is due to the husband, his sperm being scarcely good enough to cause conception.

So prevalent has sterility become that many of the large hospitals have established sterility departments. Charity hospitals also have taken up the same work, in order that those who cannot afford a specialist may nevertheless have the services of one. The exact extent of sterility cannot be stated, for there are few statistics.

ABOUT 15 percent of our married couples find, after they have been married a few years, that they have no children, and they go to a physician. Probably less than one fourth of these have children after treatment, leaving about 12 percent (a common estimate) to remain permanently barren. Some unions are barren because both husband and wife are of low fertility, though in many of these unions, either could have children if married to some one of high fertility.

Some unions are barren because of "antagonistic sterility;" that is, both are fertile and normal and could have children, but only with someone else.

About 40 percent of the barrenness is due to the husbands. (Estimates range from 25 percent to 50 percent but 40 percent seems to be the more commonly stated.) This does not mean that 40 percent of the husbands in childless unions are absolutely sterile. Some have closed tubes that could be opened. Some have weak sperm that will respond to treatment and could be brought to a fecundating condition, and some would have children if married to a woman of high fertility.

The scientific study of sperm, its qualities, and its treatment, is comparatively recent. Not many physicians have made a special study of this subject.

Each year about 50,000 women leave the marriage altar, later to discover that they are apparently fertile but childless. Some of these women are themselves sterile, but there remain over 40,000 who are fertile yet in whom conception does not take place.

America now has a million, or nearly so, fertile wives of child-bearing age, most of whom want children yet who have husbands with whom they cannot conceive.

ABOUT five percent of our married women are themselves fertile and must live out their lives barren and childless without the natural development that motherhood brings, or they must do something expedient—must seek some alternative. Artificial insemination would obviate this questionable method.

The physicians' estimates of the potential demand for insemination with donated sperm ranged all the way from the present demand to 90 percent of those having sterile husbands—that is, about 3000 to 36,000 per year (the present demand being those who are now asking for the insemination, plus those who are resorting to an expedient—which is not far from 3000, while 90 percent of the 40,000 fertile women who each year marry a husband from whom they can not conceive would be 36,000).

Obviously both of these extreme estimates are wrong and 10,000 to 20,000 is probably a fair estimate of the annual potential demand, some for having two children, if this possibility were more generally known and physicians were prepared to do this work.

Artificial insemination with sperm not the husband's presents many problems. Many physicians do not wish to have anything to do with it until the courts have declared where we stand, yet there is probably no law covering this matter. Several physicians thought that they could not be prosecuted if the husband and the wife and the donor have given their consent to the insemination. Other physicians wish to wait for social approval of this practice.

Furthermore, the husband may object. If the husband gives his consent and the physician takes the case, then comes the question of the donor. And the donor may be needed several times for one patient.

Women are not naturally as fertile as the animals and, while some women become pregnant on the first insemination, others need several. This adds to the problem of securing suitable donors.

Like blood transfusion, artificial insemination is really the proper work of a clinic or of physicians who are prepared to do such work.

Several physicians, both men and women, suggested that we need a "fertility" clinic, a clinic prepared to provide a staff of selected donors in order that women who want motherhood from selected sources might obtain it. The occasional contribution from a dozen men of excellent mental and physical development and of good stock would provide all the sperm an entire city would require.

WE need not fear, however, that this practice will go too far or threaten the existence of the family unit, for the practice would tend to be self-defeating in its own product, defeating direct repetition. This is because children born of selected sires would tend to be healthy and fertile and would not be in need of this alternative in order to perpetuate themselves. Needless to say, we do not like to face the necessity for the establishment of such clinics, nor the spread of such a practice, but, as several physicians remarked to me—what else can we do? The problem is here and the sooner we bring it out of secrecy and deal with it in a scientific way the better. We must face it just as we have faced other acute problems.

We have accepted, or at least tolerated, and become accustomed to, many things we at first resented and thought impossible, such as the baby show at the county fair; the boy or girl health contests; clinics to teach birth control; and artificial sterilization of the unfit. Obviously we shall soon become accustomed to the idea that nearly all women who have sterile husbands normally wish children. Artificial conception has the preference as an alternative. Departing from conventionalities thus far, most wives, for the sake of the marriage and home, do not wish to know the identity of the donor, but for the sake of the child they want this assistance from the best of sources. This makes possible to humans a privilege, in posterity, heretofore enjoyed only by thoroughbred plants and animals.

Doubtless within a few years there will be clinics to meet this need. Some 10,000 to 20,000 babies may be born every year from selected sources, while less than 500 babies per year are now being born to the men of real talent in our country.

What will be the eugenic effect on the race, if this same tendency grows?

The New Terranautics

THE author of the accompanying article is unusually qualified to express an opinion on the streamlining of automobiles or, as he terms it, the science of terranautics. This science embraces all that is known about automobiles and aerodynamics, and the author has been identified with both for many years. As a designer of motor cars and airplanes, he views the present subject from all angles, and his statements carry added significance at this time when streamlining of automobiles is creating such a furor in the industry. The reader is also referred to the article by Prof. Alexander Klemin, on the same subject, which appeared on page 76 of our February issue.
—*The Editor.*

The Findings of the Wind Tunnel Are Not Always Applicable to the Design of Motor Cars

By WILLIAM B. STOUT

THE matter of streamlining of motor cars has received so much erroneous attention, both from the automobile man who suddenly "goes aerodynamic" and the aeronautic engineer whose emoluments from aviation have suddenly diminished, who go "terranautic," that some points need very definite clearing up.

There are certain fundamentals that make the streamlining of a motor car an entirely different problem from that of an airplane, or any other vehicle. The first difference is that while the air always comes from the front in an airplane, it may come from any direction in a motor car or land vehicle. An airplane floats free in the fluid in which it flies, and no matter what the direction of the wind as related to the ground, the wind as related to the airplane always comes straight on from the nose. You can visualize this by thinking of a motor boat on a river; when this boat is cleaving forward through the water it cuts the water directly on the bow equally on both sides no matter whether it is headed upstream or down-stream or cross-current.

Streamlined shapes as related to airplanes and boats therefore have no place on a motor car or railplane, where the vehicle is fastened solidly to the ground and the wind blows over it from any direction. In this case, streamlining must simulate more the turtle or the crab than the airplane or the bird, and certainly has nothing in common with the teardrop, except sorrow.

FIGURE 1 shows the teardrop section "A," and a square section, "B," similar to the old type motor car with square corners. The shape "A" is that of a lifting wing and has three times the lift sideways that a square section, "B" would have. That means that if you make a motor car the shape of "A" in horizontal cross-section—similar to some English designs which have been promoted—the car will be three times as hard to hold on the road as the car "B," and we already know that car "B" is fairly hard to steer in a side wind as it is.

When in the streamlining of a car you also combine light weight and strength of airplane structure, then you most certainly must steer clear of high lift in the body section if you wish controlability; and not all cars of this type will be built with a weight of 7600 pounds as was an early model in this country to enable it to hold the road in side-winds. The plan view of the car must be so designed to give a minimum of side thrust in cross-winds; in other words, the shape must approximate streamlining by being completely curved in all directions with no sharp corners. Properly engineered, a great advantage may be had by streamlining.

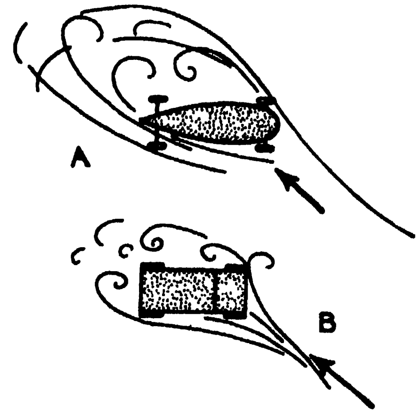


Figure 1: A "tear-drop" car design, "A," is more difficult to steer than a body of flat section, shown at "B"

In Figure 2 is shown the effect of a flat curved back to a car. The shape of the front end is not important, as the air will bank itself up in front of an obstruction and more or less streamline itself; but in back is the important part. This must be so shaped that it will form no low-pressure eddies behind the car. However, this condition varies with speed.

This type of plane, designed by the author of the accompanying article, is efficiently streamlined, but not all of the lessons learned from designs of this kind can be applied directly to the production of streamlined motor car bodies, as told in the text

In Figure 2 the curved flat top comes down to the rear of the car as shown. At low speed, as at "A," the air follows down the back of the car very cleanly and with but a very small vacuum, except at the point of drag caused by resistance underneath the car between the road, standing still, and the rough bottom of the car moving. This, at slow speed, however, does not amount to much.

As speed is increased, however, as in "B," this airflow changes. The air does not have time to follow down the steep flat stern of the car, and having no air coming in from the sides in an equal smooth curve, a vacuum area is formed with burbles and turbulence, shown by the picking up of leaves, snow or dust in this area.

Later on at a certain higher speed, the air will break completely away from the car in all directions, as in "C," leaving a long continuous turbulence behind the car, all of this suction re-

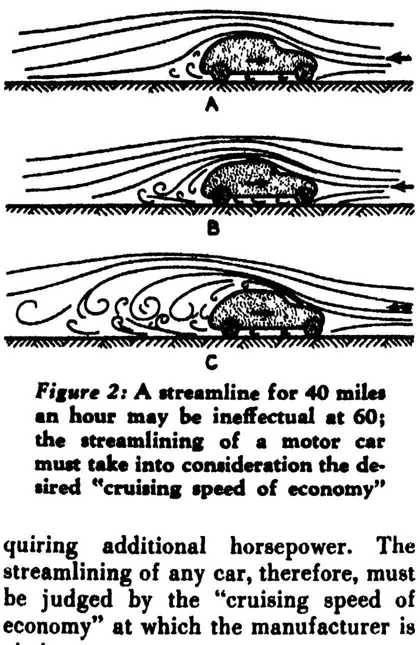


Figure 2: **A streamline for 40 miles an hour may be ineffectual at 60; the streamlining of a motor car must take into consideration the desired "cruising speed of economy"**

quiring additional horsepower. The streamlining of any car, therefore, must be judged by the "cruising speed of economy" at which the manufacturer is aiming.

Figure 3 shows an automobile engineer's idea of streamlining; a very sharp pointed nose tapers away back to the stern. This is wonderful streamlining for a boat, where turbulence in the rear is not as important as is the cutting of the water at the front; but for air, the lines show a great vacuum area at the rear. If any manufacturer making this type of car ran his car backwards, at 60 miles per hour, the horsepower consumption would be not over half and his fuel economy equivalent.

In Figure 4 is an explanation of designing for certain economical speeds. "A" was our old type automobiles—square corners, with visor on top of the windshield (which, by the way, would consume about six horsepower), exposed lamps, bad air conditions between fenders and hood, and so on. On these old cars the best fuel economy was ob-

Streamlining as applied to a "railplane" by the author. Every vehicle to be streamlined presents a different problem that must be solved independently

tained at between 35 and 40 miles per hour. Next, we came to the slanting windshield type with rounded corners and fenders straight into the hood. This next change in air resistance stepped the most economical speed up to approximately 48 miles per hour; the slanting back, or smoothed-in trunk, or even double spare tires on the rear adding to the economy.

By a greater extreme of streamlining, as shown in "C," it is very easy to increase the most economical cruising speed of a car to 60 miles per hour, or better. This will be the next step in motor car streamlining development.

The aerodynamic man will come

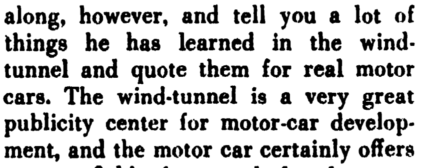


Figure 3: **A pointed radiator is not good streamlining for a motor car; this car would be more efficient and economical if it were run backwards**

along, however, and tell you a lot of things he has learned in the wind-tunnel and quote them for real motor cars. The wind-tunnel is a very great publicity center for motor-car development, and the motor car certainly offers a great field of research for the aerodynamic engineer; nevertheless, wind-tunnel figures on automobiles today are of absolutely no value from a quantitative point of view, on account of one single fact. So far no one has been able in the wind tunnel to simulate, or even approximate, the effect of the moving ground under the vehicle.

Tunnel figures are often given with two models—one up-side-down—placed wheel to wheel, but this is not a simulation of the actualities because there is no ground effect when a model is tested in this way. If the model is tested on a floor, then the drag is not the same as it is in a motor car where the rough ground is continuously moving at high speed under the wheels. Even a method of doing it with a traveling belt has not been developed to a point where it means anything in accuracy. However, great progress is being made if only in acquainting the public with the absolute necessity of cleaner lines for automobiles, of the possibilities of greater roominess inside, greater head room, greater luggage space, more luxury; and more than that, much easier riding through the adoption not only of streamlining but of the other principles which the automobile has already adopted from the airplane: Light structure, balloon tires, pyroxylin finishes, and "knees" which are really airplane landing gears with independent wheels attached to automobiles.

WITH all that aviation has to offer to the motor car, we may look for tremendous changes in this field dur-

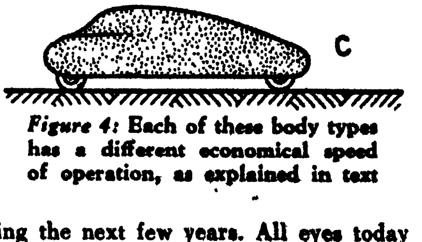


Figure 4: **Each of these body types has a different economical speed of operation, as explained in text**

ing the next few years. All eyes today are focused on airplane engineering as a way to lead all vehicles of travel out of old conventions into a new possibility of faster, better service at lower costs, and decreased risks.

Science Suits Fashion's Fads

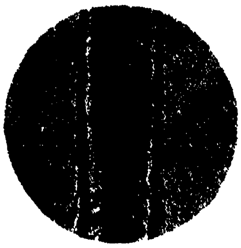


Figure 1

Figure 2

By LLOYD W. DAVIS
Chemist, National Oil Products Company

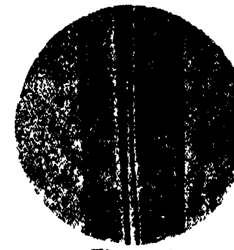


Figure 3

BRIGHT and shining objects always attract us. That is why we value gold and precious stones, why we polish our metal tools and utensils, varnish our wooden furniture, shine our shoes, and lacquer our automobiles.

That, too, is why we hold silk, with its shimmering, lustrous sheen, in higher regard than wool or cotton.

Silk, like all other desirable and expensive materials, has been imitated, and very successfully, too. In fact, in one respect at least, the imitation surpasses the original—artificial silk, or "rayon," has a higher luster than natural silk.

This, however, was going too far. After all, silk is silk—the premier among textile fabrics—and rayon, by conspicuously differing from it even in a desirable feature, merely proclaimed thereby its own artificiality. Hence, rayon chemists were called upon to find some means of reducing the luster of their product.

In attempting to solve this problem, these chemists were guided by the knowledge that a rod of glass is more lustrous than a rod of wood for two reasons: First, its surface is smoother and therefore reflects light better. Secondly, as is the case with all transparent objects, some of the light rays penetrating the interior are reflected back, thus intensifying the surface reflections.

CONSEQUENTLY, a glass rod can be made less lustrous either by roughening the surface, as by etching or painting it, or by reducing the transparency in any manner.

With these facts in mind, a glance through the microscope at the various fibers shows why silk is more lustrous than wool or cotton, and why rayon is more lustrous than silk.

Wool fibers, it will be observed (Figure 1), are crossed at frequent intervals by irregular lines. These lines are formed by the sharp teeth of little scales, which interlock when the fibers are pressed together and give wool its felting properties. They break up the surface of the fibers, and, by preventing extensive reflections, give wool its dull appearance. The scales may be rubbed off by long wear and then the characteristic shiny spots of old garments appear.

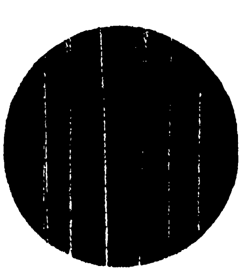


Figure 4

Cotton fibers, under high magnification (Figure 2), look like twisted ribbons. Here again there are no long surfaces to reflect the light, so that untreated cotton goods are non-lustrous also. By special treatment, such as mercerizing or the use of heavy pressures, the cotton fibers can be straightened or flattened out and thus rendered more brilliant.

Fibers of silk (Figure 3) and rayon (Figure 4) both resemble glass rods under the microscope and, consequently, are lustrous. It can be plainly seen that the rayon fibers are somewhat smoother and more transparent than the silk fibers, and this explains their superior glossiness.

Since rayon is a synthetic product, it is entirely feasible to reduce the luster of the fibers by decreasing their transparency. Figures 5 and 7 illustrate two methods by which this is done. In the first case an emulsified white mineral oil was added to the solution of rayon material before the fibers were formed; in the second case, a pigment, such as titanium oxide was used. In either case, success is attained only when very small particles of approximately the same size are uniformly distributed through the fibers—which presents a very neat little problem in physical chemistry.

However, this problem was satisfactorily solved, and rayon fabrics with almost any desired degree of luster can be produced at will.

Then a somewhat strange thing happened. The very dull rayons—which are much less lustrous than silk—caught the popular fancy, and silk, perhaps for the first time, found its supremacy challenged. Something had to be done in order to make it as attractive as its imitator! It, too, had to be delusterized.

HERE was another problem for the chemists. The method used to delusterize rayon could not, of course, be applied to silk as there is no way of introducing foreign matter into the fibers of silk. Hence, the only possibility was to find some method of effectually roughening their outer surfaces.

A large number of methods of coating silk fibers with various substances have been devised, but many of these are not altogether satisfactory because the applied material may come off due to wear or washing, leaving shiny areas. Finally, a very careful study of the structure of the silk fiber showed the way to a clever method of overcoming this difficulty.

Silk fibers are not entirely smooth, but are marked with longitudinal lines of varying length. Careful microscope scrutiny has shown these lines to be cracks or fissures in the fibers. It was also found that when silk fibers were soaked in certain liquids, the fibers swelled to their normal proportions and the fissures closed again. Advantage of this fact is taken by applying the delusterant to the silk fibers when they are in their swollen state. A certain amount of the delusterant enters the fissures and is held there firmly when the fibers are dried out again. By this process it is possible to deluster silk (see Figure 6) permanently under normal conditions of dyeing, wear, and washing.

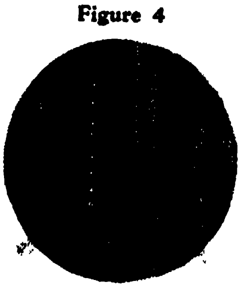


Figure 5

Figure 6

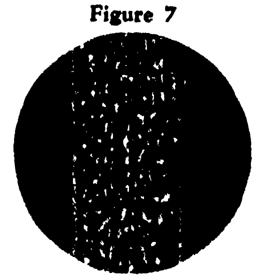
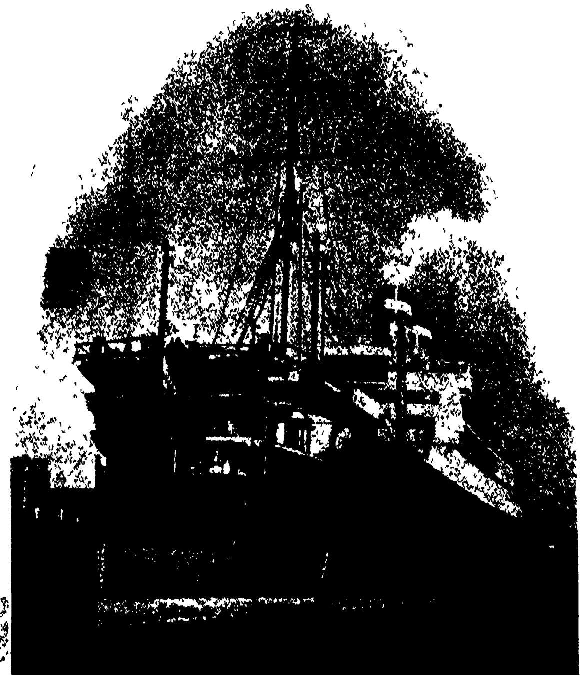


Figure 7

Ocean Liners Get New Bows

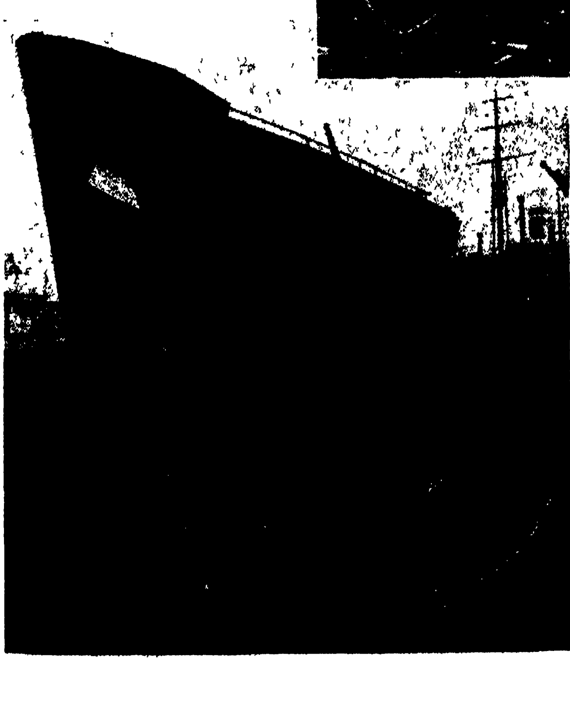
FOR the dual purpose of attaining greater operating economy and improved passenger accommodations, four Hamburg-American liners are being lengthened and provided with new bows. It is expected that the last of the rebuilt ships will be back in service by July of this year. The new bows, which are of better design than the old ones, are constructed as units. Then the old bow is partially dismantled while the ship is still afloat, and completely removed when she enters drydock. The new bow is welded to the remainder of the liner, a 28-foot section being inserted to lengthen the ship.



Above: The S. S. *Hamburg*, with old bow partially dismantled, is ready for the drydock. The work is carefully scheduled so as to keep the ship out of service for as short a time as possible. Therefore, the new bow is completed in the Blohm and Voss yards before the ship finally enters the drydock

Right: The old bow has been completely dismantled and the remains of the double bottom are being removed. The ship is now in position for the new bow and the joining section to be welded in after perfect alignment

Below: The new bow, mounted on a slideway, is being slowly pulled up to the waiting ship by means of heavy tackle. When the bow reaches the proper point, the joining section will be placed and the welding completed



Right: One of the liners afloat after reconstruction, showing the graceful and efficient curves of her new bow. It is said that this new shape will permit the same average speed, but will require only 20,000 horsepower instead of 28,000 as formerly. Photographs on this page are used through the courtesy of the Hamburg-American Line

Testing milk by the microscopical method; how the smear is made

THE AMATEUR AND HIS MICROSCOPE—IX

EXAMINING MILK FOR

MILK, "the perfect food" is also well liked by our friends and enemies, bacteria. Most of these bacteria are harmless, while others, such as typhoid and diphtheria, cause disease and sometimes death. The more progressive dairies are guarding you against the invasion of these sub-visible enemies with a battery of microscopes. Let us see for ourselves how this is being done.

There are two ways of making a routine examination of milk for bacteria. One is the "plate" method, in which a petri dish filled with agar-agar and beef broth is inoculated with the milk and then kept at body temperature for one or two days. Every single bacterial cell that was in the sample of milk will rapidly reproduce, so that when the plate is examined after incubation there will be a colony of bacteria for each one. In routine work these colonies are merely counted under a specified magnification of 3½ times. The Bausch and Lomb Engraver's Glass, or its equal, is specified in "Standard Methods of Milk Analysis." The total is then multiplied in accordance with the size of the original sample. There are several drawbacks to this method, which we need not enter into here.

The other method is the microscopical, developed by Doctor Robert S. Breed of the New York State Agricultural Experiment Station. This method is quite simple, and is easily duplicated by the amateur, except for the counting. Actual counting involves accurately calibrated special pipettes and an eyepiece for the microscope, the exact field of which is known. Even with these two necessities it really takes quite a bit of experience before the technique can be relied upon. Here is how the expert does it. The following is a quotation from Circular No. 58 of the New York State Agricultural Experiment Station, "Counting Bacteria By Means Of The Microscope," by Robert S. Breed and James D. Brew:

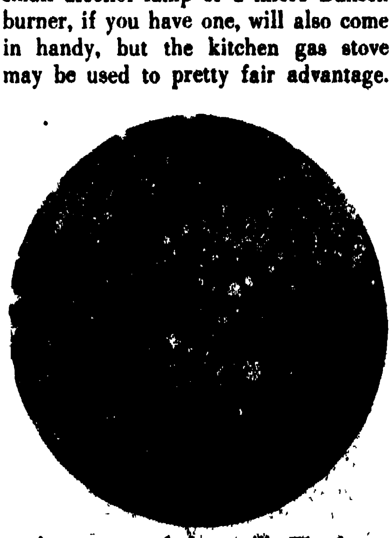
"In brief, the technique used in making counts of the number of bacteria in milk by the direct microscopic method is as follows: One hundredth of a cubic centimeter of milk or cream is measured by means of a *clean* capillary pipette accurately calibrated to discharge this quantity of milk. The milk or cream is deposited on a *clean* glass slide. By means of a stiff needle the drop of liquid is spread evenly over an area of one square centimeter and *dried quickly* in a warm place protected from dust, flies, and cockroaches. The surface on which the slides rest must be level in order that the films may dry evenly.

"THE dry smears are then prepared for microscopic examination by immersing the slide in xylol or other fat solvent for one minute, or longer if desired. After this the slide is drained and dried, immersed in 70 to 90 percent grain or denatured alcohol for one or more minutes, then transferred to a fresh, saturated, aqueous solution of methylene blue. Old or unfiltered solutions are to be avoided as they may contain troublesome precipitates. The slides remain in this solution for five seconds to one minute or longer, depending on the effect desired. They are then rinsed in water to remove the surplus stain and decolorized in alcohol. This takes several seconds to minutes, during which time the slide should be under observation in order that it may be removed from the alcohol before decolorization has proceeded too far. When the decolorization is completed the general background of the film should have a pale blue tint. Where staining has been prolonged a deep blue margin or deep blue central patches may persist. These deeply stained areas do not contain more bacteria than other parts of the film and may be removed, if troublesome, by decolorizing and restaining lightly.

"After drying, the slides are ready for microscopic examination, or they may be filed away and preserved indefinitely. Poorly stained slides may be decolorized and restained as many times as necessary without any apparent injury. If desired, the films may be mounted in Canada balsam with cover glasses, but in routine work it is customary to apply cedar oil directly to the film for examination under an oil-immersion lens."

BY eliminating a few steps in the standard method, you can see, even without an oil-immersion lens, bacteria and leucocyte cells in the milk now in your ice box. It will take you about 15 minutes.

Set out on your work table the following items: a half ounce of milk, a half ounce of cream, a clean glass rod, xylol, denatured alcohol, methylene blue, a clean medicine dropper for the methylene blue, ordinary glycerine, two flat dishes such as petri dishes or saucers, and two clean glass slides. A small alcohol lamp or a micro Bunsen burner, if you have one, will also come in handy, but the kitchen gas stove may be used to pretty fair advantage.



Appearance of clean milk. The fat globules not entirely dissolved

By **JOHN F. BRANDT**

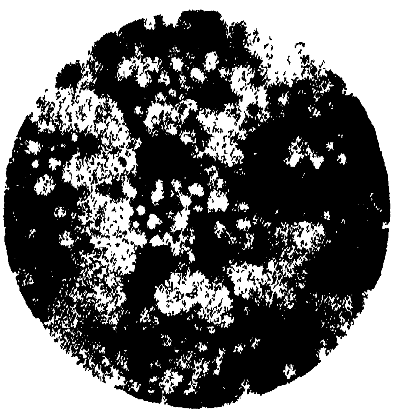
Bausch and Lomb Optical Company

BACTERIA

Now for the procedure: Dip the tip of the glass rod into the milk and make a thin smear, about the size of a dime, in the middle of one of the slides. Using the other end of the glass rod, make a similar smear of the cream on the other slide. See that the smears are quite thin and that the milk or cream is spread evenly. To dry the smears, hold them perfectly horizontally over the flame of the gas stove, alcohol lamp or Bunsen burner. The heat should be very gentle, and not enough to hurt your hands.

Pour into one of the flat dishes enough xylol to cover the slides. Let the slides stand in this for a minute or two in order thoroughly to dissolve the fat. Take the slides out and let them drain off into the dish. Set them aside with one end resting on the glass rod until they are quite dry, since xylol and alcohol do not mix.

Now pour into the other flat dish enough denatured alcohol to cover the slides, and immerse them in it for another few minutes. Remove them from the alcohol when the smears appear translucent instead of opaque white; allow them to drain and set them in front of you, making sure that they are quite flat.

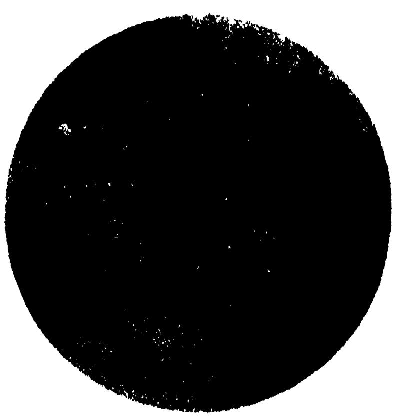


Leucocyte cells (large, round, blue) and bacteria (much smaller objects)

With the medicine dropper, put a small drop of methylene blue on each smear, spreading it around so that it is even over the entire surface, but in spreading do not touch the smear itself. Allow the slides to stand for about two minutes.

At the end of this time, the slides will be over-stained. This is a common practice in microscopy because it insures thorough penetration and the dye can always be dissolved out of those parts where it is not wanted, and lightened in the others.

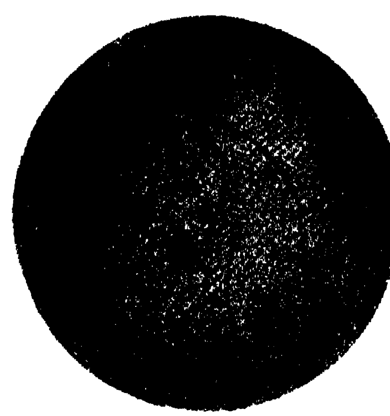
Since this subject of staining and dyeing is so interesting, let us digress for a moment while we are waiting for the methylene blue to act. Stains and the knowledge of them are an extremely important part of the microscopist's equipment. Microscopists have found stains that will pick out particular parts of structures, color them beautifully and leave the rest untouched; that is, the stain can be washed out of all the parts except those particular parts for which it was intended. Thus we can stain for nerve ends, or for muscles, or the nuclei in a cell, or for red corpuscles or white corpuscles, and almost anything else we wish to study. After we have stained the special part, we can make it stand out even more clearly from the rest by simply choosing a contrasting stain for all the other parts.



Spore forming rods of Bacillus subtiles. The word bacillus means rod

Of course, it is often desirable to use a stain that is not quite so particular. Methylene blue is an example. Methylene blue is very useful for staining bacteria and protozoa, and so on, since it colors the whole organism, making it more opaque. With stains like methylene blue we merely intensify the contrast in what would otherwise be an almost transparent substance. Incidentally, methylene is a "vital" stain. By adding a little to the water in which living organisms are swimming under your microscope, you can stain them without killing them. Replace this colored water with clear water by drawing off the colored water with a blotter and pipetting in clear water at the same time. Another stain, neutral red, can be used as a contrasting hue if you wish.

Now if we go back to our milk slides, we shall find that they are stained a very deep blue. Rinse off the excess dye under cool water from the tap, and set the slide back in the dish containing the denatured alcohol. It may take several minutes, but watch the slides carefully now, agitating the alcohol back and forth over them every once in a while, until they become quite a light blue. The dye will dissolve out of the milk much faster than out of the bacteria, but if left too long the bacteria will be decolorized also. If the stain appears too markedly uneven, it may be best, saving time in the long run, to decolorize completely and restain.



Chain of heat-resisting bacteria growing in some pasteurized milk

When decolorized sufficiently, rinse the slides off again under the tap and allow them to stand until dry. When dry, put a drop of glycerine on each smear and examine under your highest power on the microscope; 300X will do, but the higher you go the better will you see the bacteria. A cover glass is not necessary. If you have an oil-immersion lens, put a drop of oil directly on the smear instead of the glycerine, rack the lens down until it just touches the oil, and focus. Glycerine has a high refractive index, nearly equaling glass, and so it increases the resolution. It is always best to put a drop of glycerine, or even water, on any dry specimen such as a fly's wing, a hair, strands of cotton, and so on. Glycerine may be washed off the slide with water; immersion oil by dipping the slide in xylol.

Examination of the photomicrographs accompanying this article will give you some idea of how the slide should look under the microscope, and what bacteria you are seeing. Remember, however, that if your milk was pasteurized, it is quite probable that some of the bacteria were dead before you started, so do not jump to any rash conclusion. Dairies do not attempt to eliminate all of the bacteria in milk. Their job is to see that the bacterial count is kept down to certain limits and only the harmful bacteria eliminated entirely.

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What preference have you for future articles in this series?—Editor.

Possibilities of

ELECTRO-STATIC GENERATORS

By NIKOLA TESLA*

THE knowledge of static electricity dates back to the earliest dawn of civilization but for ages it remained merely an interesting and mystifying phenomenon. Virtually nothing was done towards the development and useful application of the principle. The first distinct stimulus in this direction was given by the discoveries of Franklin and Leyden in the latter part of the 18th Century.

In 1777 Cavallo devised a cylindrical friction machine and from that time on there was a slow but steady evolution of friction and influence machines until the modern Wimshurst, Holtz, Toepler, and other types were produced. Among these machines the one invented by Wommelsdorf 30 years ago was, probably, the most effective. It yielded a current of six-tenths of a milli-ampere and in the present state of science it could be successfully employed for charging large aerial capacities and stepping up its terminal tension of 150,000 to many millions of volts.

Numerous attempts have also been made to generate static electricity by friction of fluids and solid particles but from the earliest records to this day the belt has proved to be the simplest and most convenient means for the purpose. Static electricity from this source gained in importance when evidences accumulated that it was capable of interfering seriously with operations and causing accidents in paper factories, flour mills, and similar establishments. In the early nineties my electrodeless vacuum tubes became extremely popular and were frequently lighted from belts and later Roentgen tubes were operated in the same manner. It is quite easy to improvise such a generator and obtain interesting results under favorable atmospheric conditions.

A remarkable device of this kind, embodying new features, has been recently developed by Dr. R. J. Van de Graaff at the Massachusetts Institute of Technology, and is attracting extraordinary attention. (See page 96, February, 1934, SCIENTIFIC AMERICAN.—*Ed.*) It is hailed as a revolutionary invention with which wonders will be achieved. The technical papers refer to it as a Colossus, a Master Key expected to unlock the secrets of nature. Naturally enough imaginative scribes have built Spanish castles on this foundation. So it comes that even such an ably edited paper as *The New York Times* informs its readers of a contemplated use of this generator for long distance transmission of power. According to a *bona fide* report in its issue of December 5, 1933, "the possibilities of the colossal generator have been worked out in theory and it now remains to apply it in practice." However visionary this scheme may appear it is not absolutely impossible. A wise Macedonian king said: "No wall is so high that a mule loaded with gold could not jump over it." With unlimited capital and regardless of returns, it might be carried out.

The Van de Graaff generator, shown housed in an aircraft hangar, is discussed by Dr. Tesla in the accompanying article

In view of many articles and editorials written in the same vein, which have amazed the layman and amused the expert, it may not be amiss to examine the merits of this odd contrivance in the light of well demonstrated scientific facts.

But first I want to point out an apparent discrepancy in the descriptive reports and photographs showing the apparatus in action, which is illustrated in the accompanying photographs, and consists of two aluminum spheres 15 feet in diameter supported on insulating columns six feet in diameter. Electricity is supplied to the spheres by paper belts charged from a "sprayer." With terminals of such dimensions much higher voltages should be obtained. In most of the treatises it is assumed that the surface-density, that is, the quantity of electricity stored per square centimeter of a spherical conductor, can not exceed eight electrostatic units without a breakdown of the surrounding air. As a matter of fact the density can be pushed up to 20 units before power-consuming streamers appear.

THIS being the case, the limiting voltage of a sphere having a diameter of 15 feet should be 16,964,700 and, consequently, the potential difference between two such oppositely charged spheres, very far apart, is 33,929,400 volts. It may be useful to state, however, that such large spheres placed at a distance of 55 feet between centers, as contemplated, will influence each other to a considerable extent, increasing their capacities. At this distance the increase will be about 16 percent, which should be taken into consideration when estimating the charge.

The desired difference of potential could be obtained with much smaller spheres and it would seem preferable to employ them as they would yield sparks in quicker succession. Some of the photographs under the terminal pressure of 7,000,000 volts are puzzling because the surface-density in this case was

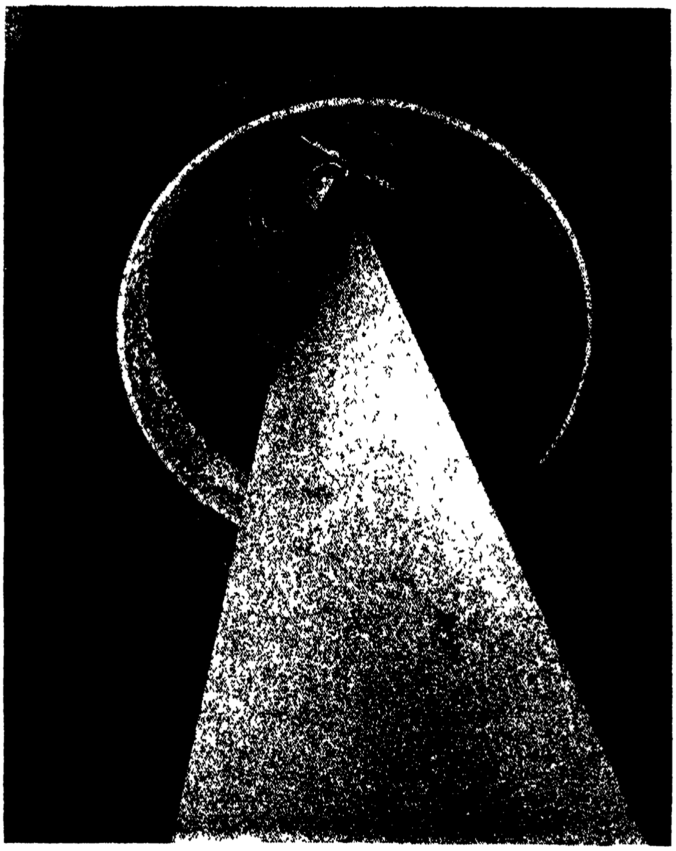
*See page 115.

only a little over 4 electrostatic units. Furthermore, sparks are shown to pass copiously along the insulating supports. This is a serious difficulty encountered in working with very high tensions but by properly shaping the under side of the sphere and resting it on a support well up in its interior, besides providing a liberal side clearance, the discharges are prevented from following the column and no further trouble is experienced even with the highest potentials. My wireless tower on Long Island, erected in 1902, carried a sphere which had a diameter of 67½ feet and was mounted in this manner. It was to be charged to 30,000,000 volts by a simple device for supplying static electricity and power.

MOST people, and not a few electricians, will think that very long and noisy sparks are indicative of great energy, which is far from being the case. An impressive display of this kind, at several million volts, can be readily obtained with any wide leather or fabric belt in dry weather. The only requirement is that the outward surfaces of the highly charged capacity elements be arranged along an ideal boundary everywhere of small curvature. But the electrical energy is trifling and this applies to all electrostatic generators which have been proposed, irrespective of size.

One does not need be an expert to understand that a device of this kind is not a producer of electricity, like a dynamo, but merely a receiver or collector with amplifying qualities. All its energy is derived from electricity which is generated through friction or supplied by the sprayer and pumped into the terminals by the belts. If the columns were as tall as the Empire State Building and the spheres 500 feet in diameter the monstrous machine could not have any more energy than is supplied to it by the electrified belts and no matter how much improved, this type is fatally doomed to small output and low efficiency on account of the existing limitations and the wastefulness of the process of conveying the charges from their sources to the terminals.

As the writers of articles regarding the "Colossus" confine themselves to extolling its size, voltage and possibilities, but give little hint regarding its mode of operation and power performance, I shall endeavor to advance the needed knowledge. With this object let it be assumed that the spheres are placed at a distance of 55 feet from center to center and that the potential difference between them is 10,000,000 volts. Ordinarily, the electric capacity of such a sphere is equal to its radius, namely 225 centimeters, but as before explained, 16 percent should be added to this, making 261 centimeters equivalent to 0.00029 microfarad. Consequently, when the regime is established, each sphere being at a potential of 5,000,000 volts, the electricity stored on each will be 0.00145 coulomb. If this quantity were supplied every second, the current would be 0.00145 ampere. An incandescent lamp of 25 watts requires a current 150 times more intense.



Looking up through one of the insulating columns of the Van de Graaff generator, showing the endless paper belt

In estimating the amount of electricity furnished to each terminal per second, only the sprayer need be considered as it supplies much more than could be generated by friction of the belts. The device used has not been clearly described but it is sufficient for the purpose of this dissertation to know that it operates at 20,000 volts and energizes, through rows of points, the two belts which are said to be four feet, or 120 centimeters, wide. Assuming that they are run at a speed of 100 feet or 3000 centimeters per second, the area covered in this time interval would be 120 x 3000 = 360,000 square centimeters. If it were possible to charge the belts uniformly to a surface density anything like that existing on an electrified particle, the output of the machine would be very great. But this can never be realized. The following approximate estimate will show what may be reasonably expected.

The discharge of electricity from points has been extensively investigated and from the data available and my own observations I find that the current through each point at 20,000 volts will be about 0.0001655 ampere. No advantage would be gained by a very close spacing of the points on account of their mutual reaction but I shall make allowance for as great a number as seems practicable, say, 200, in which case the integral current would be 200 x 0.0001655 = 0.0331 ampere.

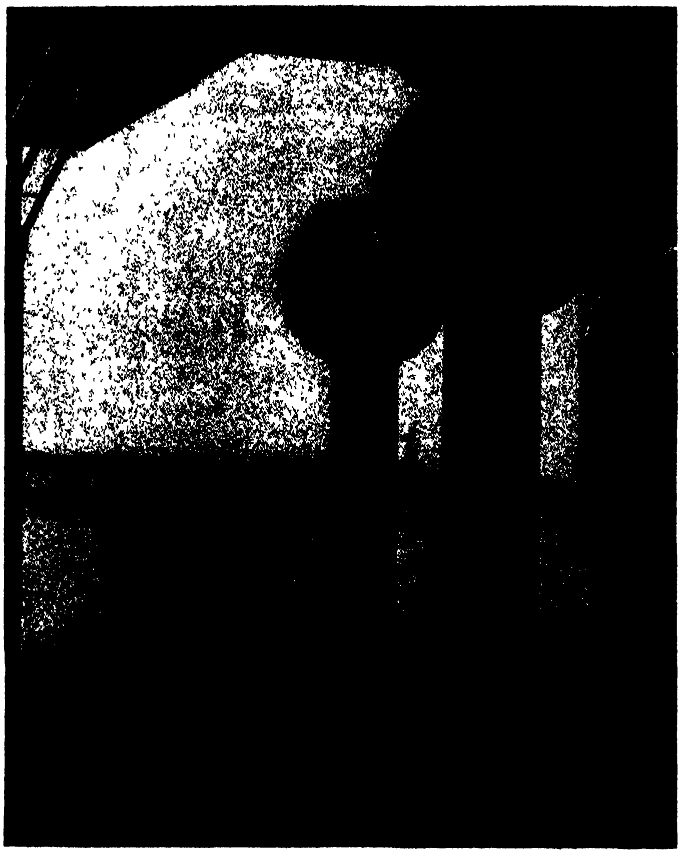
NOW, electricity is transferred from the points to the belt by minute bodily carriers—the molecules of the air. When such an electrified particle comes in contact with a large conducting body it gives up almost all of its charge to the same, but to an insulator, as the belt, it can impart only a very small portion owing to the strong repulsion between the charge deposited and that remaining on the particle. From theoretical considerations it appears that the part usefully applicable will, in all probability, not exceed 1/150 of the whole charge on any particle thrown against the belt. The current from the sprayer is 0.0331 ampere, that is to say, it conveys a total charge of 0.0331 coulomb per second and of this the belt will carry off only 0.00022 coulomb equivalent to a current of 0.00022 ampere. This means that 99.33 percent of the energy supplied by the sprayer is lost, and illustrates the appalling inefficiency of this method of electrification.

As will be seen, the device delivers to each belt energy at the insignificant rate of 4.4 watts and is, therefore, virtually of no effect on the power output of the machine except that it imposes a limit to the same. This is important to remember in view of the general impression created by the earlier reports that all the energy is drawn from the sprayer. Since the quantity of electricity stored on the spheres remains constant it is evident that the overflow current between them under normal working

conditions must be 0.00022 ampere so that at the potential difference of 10,000,000 volts the machine should develop 2200 watts.

As the supply from the exciter is entirely negligible the questions will be asked: Whence comes this great energy and power? How is it produced? The answer is simple. It is derived from the belts which perform the work of transporting the charges imparted to them against the repulsion exerted by the spheres. This force can be approximately determined. The permanent charge on a sphere will be, as shown above, 0.00145 coulomb or 4,350,000 electrostatic units. But 16 percent of this quantity is "bound" and should be left out of consideration. With due regard to the opening on the underside, the free capacity of each terminal may be estimated 222 centimeters, so that at five million volts Q = 222 x 5,000,000/300 = 3,700,000 electrostatic units. The moving charge will be distributed over a length of the belt about equal to the height of the insulating column and with some allowances it may be taken at 24 feet. Assuming a belt speed of 6000 feet per minute this distance will be traversed in 0.24 of a second and, consequently, the belt charge to be considered is 0.24 of the whole carried per second; that is, 0.0000528 coulomb or 158,400 electrostatic units. The upper end of the charged area is 7½ feet and the lower 31½ feet from the center of the sphere. The former is thus r = 225 c.m. and the latter d = 945 c.m. The charged area of the belt being 120 x 720 = 86400 square c.m., it follows that the density of the charge is 158400/86400 = 1.8333 electrostatic units. Accordingly, if the distribution of the charge is perfectly uniform, a transversal strip of the belt one centimeter long will contain a quantity q = 120 x 1.8333 = 220 e.s.u.

Considering now a surface element of vanishing length dx, the charge on the same will be qdx = 220 dx e.s. units of quantity and that on the sphere being Q = 3,700,000 e.s. units, the repulsive force acting on the surface element at a distance x from the center of the sphere, will be $\frac{Qq}{x^2}dx$. Integrating this expression between the limits r and d, and substituting the values for Q and q, the force repelling the charged side of the belt is found to be $F = \frac{Qq\,(d-r)}{rd} =$ 2,756,420 dynes or 2.81093 kilograms. At a speed of 100 feet or 30 meters per second the work is 84.3279 kilogram meters per second, equivalent to 0.82691 kilowatt. Both belts will therefore perform the work of 1.65382 kilowatts. This is 33 percent less than the theoretical electrical activity of the machine and as the power developed by the belts must be, at least, equal to the electric power one is apt to reach the conclusion that the sucking points do not draw off the entire charge, as has been tacitly assumed, and the current, instead of being 0.00022 will be proportionately smaller, that is, 0.0001654 ampere. But this view is found untenable for the limit to performance is imposed by natural law and not by the defects of a device which, moreover, could be readily improved. The discrepancy between the calculated power of the belts and the electric activity of the machine was all the more puzzling as the two quantities could not be harmonized by imagining any kind of theoretical working conditions. Finally, however, I recognized that the charge can not be uniformly distributed on the belt but must increase from the lower to the upper portion of the same. Indeed, such an effect might have been expected although the surface charge on an insulating body is not very mobile.



Another view of the high-voltage generator. Tracks are provided so that the equipment may be rolled out into the open

Suppose that the belt carried a film of oil meeting with a downward current of air. The obvious result would be a thickening of the film toward the top. Similarly, the electric film on the belt is "thickened" through the repulsion exerted by the terminal and the attendant piling up of the charge and it is only so that the exact balance between the mechanical and electrical power can be, under all conditions, automatically established. (See explanatory note on page 165.) The equality of these two quantities is an absolute and inevitable consequence of the law of conservation of energy, the remarkable feature of this process of dynamo-electric transformation being that it is effected with the highest efficiency, apparently without evolution of heat. Of course, there are great losses in the operation of the machine, but they do not concern the process itself.

In an instrument designed primarily for scientific investigation, the efficiency is of relatively small importance and I shall dwell on it for the sole purpose of showing that in any application as a power producer such a generator would be hopelessly handicapped. The air friction of the belts at a speed of 30 meters per second will require about 3.73 kilowatt. With the repulsion work, the load on them will be 5.93 kilowatt. Under the working conditions as outlined, the belt drive may have an efficiency of 90 percent and the motor 85 percent so that energy will be drawn from the electric mains at the rate of 7.75 kilowatt. The net performance of the sprayer at 20,000 volts will be 1.324 kilowatt but taking into account the efficiency of the whole apparatus, at least 1.6 kilowatt must be assumed. There are also dielectric, magnetic, and radiation losses, making the total power input, perhaps, 9.5 kilowatt while the output is only 2.2 kilowatt. If this estimate is reasonably approximate, an over-all efficiency of 23 percent is about as high as can be expected from any electrostatic generator of this kind.

It was shown that the charge on each sphere at 5,000,000 volts is 0.00145 coulomb but as only 0.00022 coulomb can be furnished per second, it will take about 6.6 seconds to charge the spheres to the full potential. I have assumed

(Please turn to page 163)

Two of the four round and rectangular temples recently discovered in demolishing an old sunken square near the Corso of Rome

ROME'S ARCHEOLOGICAL TREASURES

A NUMBER of years ago the Italian Premier, Benito Mussolini, began to "sell" Italy to tourists and he has been highly successful. He realized that a few million lira spent on opening new roads, improving existing ones, and opening up new excavations would be returned a hundredfold. Among his projects are the Via dell' Impero which wipes out a whole slum district between the Coliseum and the great memorial to Victor Emmanuel. Every demolition serves to open up some object of antiquity generally very worth while.

Through the courtesy of the Italian Information Office we are enabled to present some of the latest views of archeological finds in Rome and vicinity. Among the recent excavations is one in the Largo Argentina, a low lying square off the Corso or main street of Rome. The four ruined temples in the Largo Argentina are important in so far that they retain much of their original appearance as of the 3rd Century B.C. The temples were brought to light during the demolition of blocks of buildings, and the ruins are being enclosed by gardens. The first temple found near the entrance is rectangular, while adjacent to it is a round one.

Right: The capitol rises over the Forum where some remarkable discoveries are still being made. The columns of three temples are in the middle background

A temple at Ostia, Rome's old seaport at the mouth of the Tiber

The third and fourth temples are rectangular. At this late date such an aggregation of temples in the heart of Rome is certainly a great find. It has not been ascertained to what deity they were dedicated, but their intact position affords evidence that they continued to be venerated under the Empire. In the picturesque view of the capitol are shown excavations which are being carried on in front of the three temples of Saturn, Vespasian, and Concordia.

Ostia, seaport of ancient Rome, abandoned to her own devices, underwent destruction and pillage at the hands of the barbarian; the atmosphere completed the work of destruction. The Italian Government began systematic excavations in 1910 and a trip to Ostia should be included in all Roman excursions.

Some New Astronomical Advances

Astronomical Gains Made Public at the Recent Boston Meeting of the American Association for the Advancement of Science and Its Associated Organizations

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President, the American Association for the Advancement of Science

THE continental expanse of the United States imposes troublesome conditions upon its scientific meetings. In a compact country like England or Holland frequent gatherings are easy, but over here the mere talk of traveling to the meeting place takes more time and much more money than men of science can often afford. The Royal Society meets every week (except in vacation times), the National Academy of Sciences twice a year. Hence our American meetings have to be intensive when we do get together. The sessions are long, the programs crowded and only a skilled presiding officer can make time for the discussions which add so much to the meeting's value.

The great holiday meetings are worse than a three-ring circus; there are often a dozen things going on at once. To be sure, no one would probably be greatly inconvenienced by simultaneous sessions of the Econometric Society, the Society of Parasitologists, the Association of Physics Teachers, and the section of Geology, but when the physicists themselves have to hold their sessions in different places at the same time the congestion becomes serious. If, added to all this, the delegate must devote a deal of time to committee meetings (as fell to the writer's lot a week ago) his impressions of the present state of advancement of science must perforce be sketchy. Yet, from this whirl of memories, supplemented by some recent publications, some notable things emerge which may now be told.

FIRST comes a series of investigations of the dimensions of galaxies—our own and the distant ones which we call star clouds or nebulae. Plaskett and Pearce of the Dominion Astrophysical Observatory in Victoria report the completion of their extensive work on the rotation of the galaxy. The theory of this is an old story now. If the whole Milky Way were rotating like a solid block, so that the period of revolution was the same at all distances from the center, we would have a hard job to find it out. Distances would be unaffected, and likewise radial velocities; all the stars would circle slowly about the heavens without changing their relative positions (except for superimposed random motions) and this would not be easy to detect. But if the rotation is faster near the center (as for the planets around the sun) there is more to observe.

Suppose that the sun is one of a vast swarm of stars all moving in circular orbits. A star ahead of us in the same circle, or one behind us, will move at the same speed and not change its distance. Stars nearer the center and moving in smaller orbits will go faster. Those right between us and the center will be at their nearest, and their distances will not change; but those which are ahead of this position will draw away from us and those behind it will approach us. On the other side of our track we will catch up with the stars ahead and run away from those behind. To use a nautical analogy, if we liken the sun to a ship, advancing along its orbit with the center to the right (starboard), the stars on our starboard bow will be receding, those on the port bow approaching, while on the port quarter we have recession again and on the starboard quarter approach. This effect, which goes through all its phases *twice* in the full circle, is characteristic. The mere motions of the sun itself among the other stars would cause all stars forward of the beam to approach and all abaft the beam to recede, producing a single period instead of a double.

BOTH effects are actually present. The second is shown equally by the nearer and remoter stars, but the first obviously increases with distance, since remoter stars differ more than near ones in their orbital speed. Random motions, different from star to star, are also present, so that it is no easy task to disentangle them all. Working on the stars of spectral class B, which are very hot and bright and can be seen a long way off, the Canadian observers find that the rotational effect is prominent, especially for the stars which appear fainter to the eye, and hence on the average are more remote.

By combining this effect with others which are observable in the proper motions, it is found that the center of rotation is in the direction of the constellation Sagittarius and at a distance of approximately 10,000 parsecs, or 32,000 light-years. The center of the great system of globular clusters, located nearly 20 years ago by Shapley, lies in the same direction and at about the same distance (modifying the older estimates a little to allow for weakening of the light of these remote objects by the faint haziness which hangs in space near the galactic plain). This "obscuration" intensifies into great, almost opaque clouds between us and the center, and doubtless hides the greater part of it from human eyes.

IN the opposite direction, in Auriga and Gemini, our view is little obscured, but the Milky Way is thin and poor because we are looking only toward the outer fringes of the great irregular disk-like mass of stars. Recent studies at Harvard, reported by Shapley, show that nevertheless we see things in this direction which are as remote as 30,000 light-years. The full diameter of our system is therefore of the order of 120,000 light-years. This much exceeds that of any other known star cloud or nebula, so that we are perhaps justified in calling it The Galaxy *par excellence*, till we learn more.

The neighboring galaxies, however, are larger than we had supposed. The Andromeda nebula, for example, is much larger than had been believed. On ordinary photographs its extensions fade out within two degrees of the center. But Stebbins and Whitford, working with a sensitive thermocouple attached to the Mount Wilson 100-inch reflector, have measured the brightness of the sky-background nearby (taking care to avoid visible stars). They find that, just outside what was previously supposed to be the edge of the nebula, the background, though apparently featureless, is five or six times brighter than that of the sky at large. At greater distances it fades off gradually, but it drops to the normal value only at almost twice the previously adopted diameter.

This result, obtained with the world's greatest telescope, is confirmed by pho-

tographs taken at the new Harvard station at Oak Ridge, Massachusetts, with one of the smallest, 1½ inches in diameter and 6 inches in focal length—a high-grade camera. To reveal a faint stellar point requires a large aperture, but in photographing an extended area the *ratio* of the lens diameter to the focal length is important, as any press photographer who must work in dull weather knows. Even with so rapid a camera the outer extensions of the nebula are scarcely visible on the plate, probably because they lack detail. But measures of the opacity of the negative with the microphotometer show again that a very faint and featureless glow extends far beyond the more conspicuous portions.

The full diameter of the nebula is thus shown to be between six and seven degrees, which corresponds to about 75,000 light-years. Though smaller than the Galaxy, it is of the same general size. No other known nebula or star cloud is as big. The Great Magellanic Cloud, 85,000 light-years away, extends obviously over a region some seven degrees in diameter, but star clusters and variables of a type characteristic of a cloud reach out much farther, and show that the actual diameter of the system is 14 degrees, corresponding to 21,000 light-years. This is nothing remarkable, as nebulae go. Measures made at Harvard show that on the average the largest nebulae in 25 different nebular clusters are about 15,000 light-years in diameter. This refers, however, to the inner and brighter portions, and the tiny but powerful instrument just described shows that their extreme extent is from 25,000 to 30,000 light-years. An average nebula, even excluding the faint extensions, would be 6000 light-years across, and their number is legion. A single plate, taken recently at Oak Ridge, shows 587 "new" nebulae. Hubbell has just published a discussion of the number and distribution of nebulae, based on 1283 plates taken with the great reflectors. Though these cover scarcely more than 2 percent of the whole sky area observable at Mount Wilson, they showed 43,201 nebulae!

NO nebulae at all (of the kind here considered) are found along the central line of the Milky Way, doubtless because they are all hidden by obscuring matter within it or not far outside its limits. This obscured zone ranges from 10 degrees wide near Sirius to more than 40 degrees in the direction of the galactic center, and is bordered by a region of partial obscuration 10 degrees or 15 degrees wide on each side. All told, it must conceal from us something like one third of the distant nebulae. Allowing for this, and extending his calculations to the limit at which nebulae may be photographed with the 100-inch under the best conditions, Hubbell estimates the total number of nebulae as 75,000,000. As the count is extended to fainter and fainter nebulae the numbers increase rapidly, showing that the nebulae are strewn in space up to 200,000,000 light-years distance as thickly as they are at smaller distances. What lies beyond we do not know—our deepest soundings show "no bottom." Greater telescopes will push the search farther, but an obstacle arises in the much discussed red shift usually attributed to recession. This makes very distant nebulae appear redder than they would otherwise be and hence harder to photograph. Hubbell concludes that this effect alone prevents us from detecting two thirds of the number which could otherwise be photographed with the 100-inch telescope. For a larger instrument the effect would be still more serious.

ANOTHER set of communications delivered at the recent meeting dealt with variable stars. Pettit and Nicholson, again at Mount Wilson, report a long series of measures of their heat radiation with the thermocouple. If we could "see" heat as well as light—that is, if our eyes were equally sensitive to radiation of all wavelengths—some classes of variables would look to us about the same as now. One would naturally expect this of the eclipsing variables, since the same proportion of all rays must be cut off. Yet careful observations on Algol show that at the middle of eclipse 67 percent of the photographic light is lost, but only 63 percent of the heat. The explanation is that the companion which eclipses most, though not all, of the disk of the principal star is considerably redder than its primary, and gives out more heat in proportion to its light. Two bright Cepheid variables, Delta Cephei and Eta Aquilae, which have almost exactly the same range, show a considerably smaller range of total radiation ($0^m.52$) than of visible light ($0^m.77$) or photographic brightness ($1^m.12$). [^{m} here refers to magnitudes.] This again is fairly explicable, for it is known that their variations are due mainly to changes in surface temperature—which themselves are determined by pulsatory oscillations in diameter. As the temperature falls (from about 5300 degrees to 4500 degrees, in this case) the rates of radiation of heat and of visual and photographic light should theoretically all diminish, but in increasing amounts. The observed changes are in close agreement.

At lower temperatures the bulk of the energy is radiated in the infra-red, leaving but a beggarly fraction in the visible region. Could we see heat, therefore, the coolest stars would come up so much in brightness as to change the familiar aspect of the constellations. Betelgeuse, for example, would look as bright as Sirius, and Alpha Hercules, to actual eyes a not very conspicuous star of the third magnitude, would rival Canopus. The long-period variables would show still greater changes. Mira Ceti, which to the eye rises to the fourth magnitude at maximum, to the thermocouple is as bright as Vega. At minimum it drops to the ninth magnitude, visually, but only to the first in terms of total energy. That is, the star's light drops to 1 percent of its maximum value, the heat only to 36 percent.

This extraordinary difference is due largely but not entirely to a change in temperature. The latter can be found with some accuracy by measuring what part of the radiation is transmitted by a water-cell, which stops the longer waves. The resulting temperatures range from 2500 to 1900 degrees. Such a change would reduce the visual brightness of a standard radiating surface to 6 percent of its initial value. The difference between this and the observed 1 percent arises from absorption in the star's atmosphere. This is full of the vapor of titanium oxide, which produces enormous bands, especially in the green, yellow, and red. At maximum temperature this compound is partly decomposed and the atmosphere becomes more transparent; though even then it cuts out three quarters of the light, while at minimum a star is enclosed in an almost opaque mantle. Substantially the same behavior is shown by the other long-period variables which Pettit and Nicholson had studied.

IN the infra-red this band absorption ceases and the observations give a much better idea of what the star is really doing. Even in the region accessible to photography on modern plates this disturbance is almost absent. From the Allegheny Observatory Dr. Hetzler reported on observations made with color filters giving a working wavelength of 9600 A, which give a range for long-period variables of the order of a magnitude and a half. These great stars are among the most remarkable objects in the heavens. Measured by their heat, instead of their light, they are among the brightest objects known. Their diameters are enormous, far exceeding that of the earth's orbit, and they are in every respect super-giants. The cause of their variation is imperfectly understood. It is probable that, like the Cepheids, they alternately contract and expand, and that this causes the temperature changes; but the details, both of this and of the remarkable spectral changes, must await further study before we understand them fully.
—*Princeton University Observatory*, January 5, 1934.

In the Region of Billions of Cycles

By F. ZWICKY
Associate Professor of Physics at the California Institute of Technology, Pasadena

BY international agreement radio waves of less than ten meters wavelength are called *ultra-short* waves. These waves have recently come to the attention of the public because of the use by Marconi of 50 centimeter waves, and because of the establishment of a two-way wireless telephone connection between France and England on 18-centimeter waves.

Ever since the time of Newton and Huyghens the vast variety of electromagnetic waves has been a subject of intense interest to scientists. These waves constitute the so-called electromagnetic spectrum, which comprises in the sequence of decreasing wavelengths the ordinary and ultra-short radio waves, the infra-red, visible and ultra-violet light, the soft and the hard X rays, the gamma rays of radioactive substances and, last but not least, the cosmic rays as far as they are not swift particles of matter, such as electrons, protons, and so on.

Most of these waves have been thoroughly investigated with regard to their origin and their effects on all kinds of dead and living matter. Nevertheless, scientific research is still actively going on in all the different parts of the electromagnetic spectrum, covering wavelengths from many kilometers down to less than a trillionth of a centimeter.

Two relatively obscure regions in the electromagnetic spectrum especially appeal to the fancy of modern scientists. In the first place there are the cosmic rays, whose mode of creation is one of the darkest mysteries of modern science. These waves are of the unimaginable length of about a trillionth of a centimeter, corresponding to electromagnetic oscillations of more than a thousand billion billion cycles per second.

The general interest in cosmic rays has somewhat overshadowed the surprising advances which have recently been made in the second more modest dark region of the electromagnetic spectrum, the region of ultra-short radio waves. Ultra-short radio waves possess wavelengths from 10 meters down to about one millimeter. The scientific "age" of the shortest ones among them is now just six years, whereas the discovery of the cosmic rays by Gockel, Hess and Kohlhörster already dates 20 years back.

Ultra-short waves were produced first by means of oscillating electric sparks, and after that by means of vacuum tubes. The waves obtained from the electric spark are so badly damped that they never can be made monochromatic; that is, they are a mixture of various wavelengths. For this reason their scientific and technical applicability is extremely limited. It was therefore a tremendous advance when Professor Barkhausen in Berlin, in 1920, discovered that the tiny electrons in suitably built vacuum tubes can be induced to run

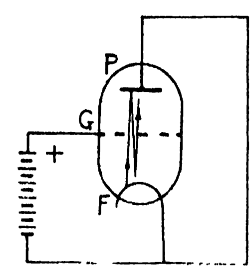


Figure 1

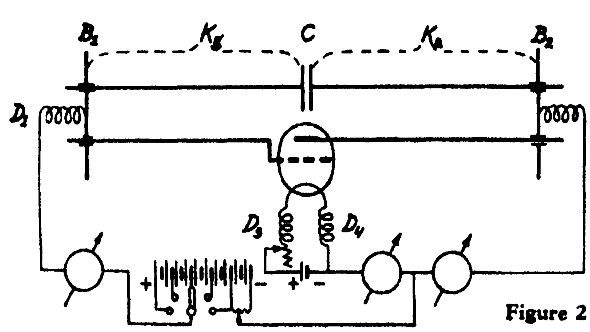


Figure 2

Upper left: **Professor Potapenko with a special tube.** *Above, Figure 2:* **His circuit for the generation of oscillations with frequencies up to several billions of cycles**

periodically back and forth between a hot filament *F* and a cold plate *P* (Figure 1) at the tremendous pace of about one billion cycles per second. During this mad dance they induce undamped oscillations in circuits which are connected to the tube and which are properly tuned. The frequency of these oscillations in the tube naturally increases as the electrons are sped up in their course by application to the grid *G* of a higher positive voltage. The frequency also increases as the dimensions of the tube are made smaller and the electrons have to run less and less far. Unfortunately, these two ways of boosting the frequency soon mutually exclude each other. Indeed, on increasing the voltage and at the same time decreasing the dimensions of the tube a point is soon reached when the materials which make up the tube are not able to withstand the resulting high electric fields, so that breakdown takes place. For these reasons physicists quickly realized that with Barkhausen's method it was not possible to produce wavelengths shorter than about 30 centimeters.

THUS, in spite of the incredibly small inertial mass of the electrons, this mass still is not small enough to permit physicists to chase the electrons back and forth more than about one billion cycles per second. For some years, little hope was maintained of ever bridging the spectral gap between the shortest Barkhausen waves of 30 centimeters and the longest infra-red heat waves of about 0.5 millimeters wavelength. But physicists kept on trying, and in 1927 Prof. G. Potapenko of the Moscow Mining Academy, working at that time at the University of Berlin, succeeded in filling the last spectral gap by an exceedingly ingenious and simple trick.

Professor Potapenko's idea is essentially this: Suppose that you are rocking a child in a swing, the natural frequency of which is such that it swings back and forth just once in exactly three seconds. The excursions of the swing will be the greatest if you push the child forward exactly every third second. However, you may find it too tiring to push so often. You therefore decide to push the child exactly once in nine seconds, and the results will still be quite gratifying. Nevertheless you will find that in the course of the two oscillations during which you are idle the excursions of the swing considerably diminish because of the frictional damping of the swing. To remedy this you may call in two more men who also push the child exactly every ninth second, but always three or six seconds after you. By this teamwork you will produce the same result as if you yourself had pushed the child every three seconds.

Applied to the oscillating electrons (pushing men) this means that we must divide them into groups which alternately replenish the oscillations of the circuits connected to the tube, just as our three men alternately replenished the energy of the swing. If, for instance, the electrons execute exactly one billion oscillations per second, which in a Barkhausen tube is the maximum frequency obtainable, we may tune the circuit (swing) which is connected to the tube to a characteristic frequency of exactly three billion oscillations per second. By proper tuning we can succeed in dividing our electrons into three groups, each of which will reinforce the oscillations in our circuit exactly every third oscillation. As the three electron groups work out of phase by exactly one or two periods of the outside circuit, the high-frequency oscillation in this circuit will be undamped and will emit monochromatic electromagnetic waves of three billion cycles frequency; that is, of 10 centimeters wavelength, in spite of the fact that the frequency of the electron oscillations will be equal to one billion cycles only, which corresponds to 30 centimeters wavelength. In this way it is possible to multiply the frequency of electron oscillations as many as 35 times.

By this ingenious method of Professor Potapenko's (see Figure 2) it is possible to obtain ultra-short waves as short as about three centimeters by application of a grid voltage of only 100 volts. The oscillations are undamped and therefore produce very nearly monochromatic ultra-short waves. In fact, it is possible to hold the wavelength constant within one part in a million.

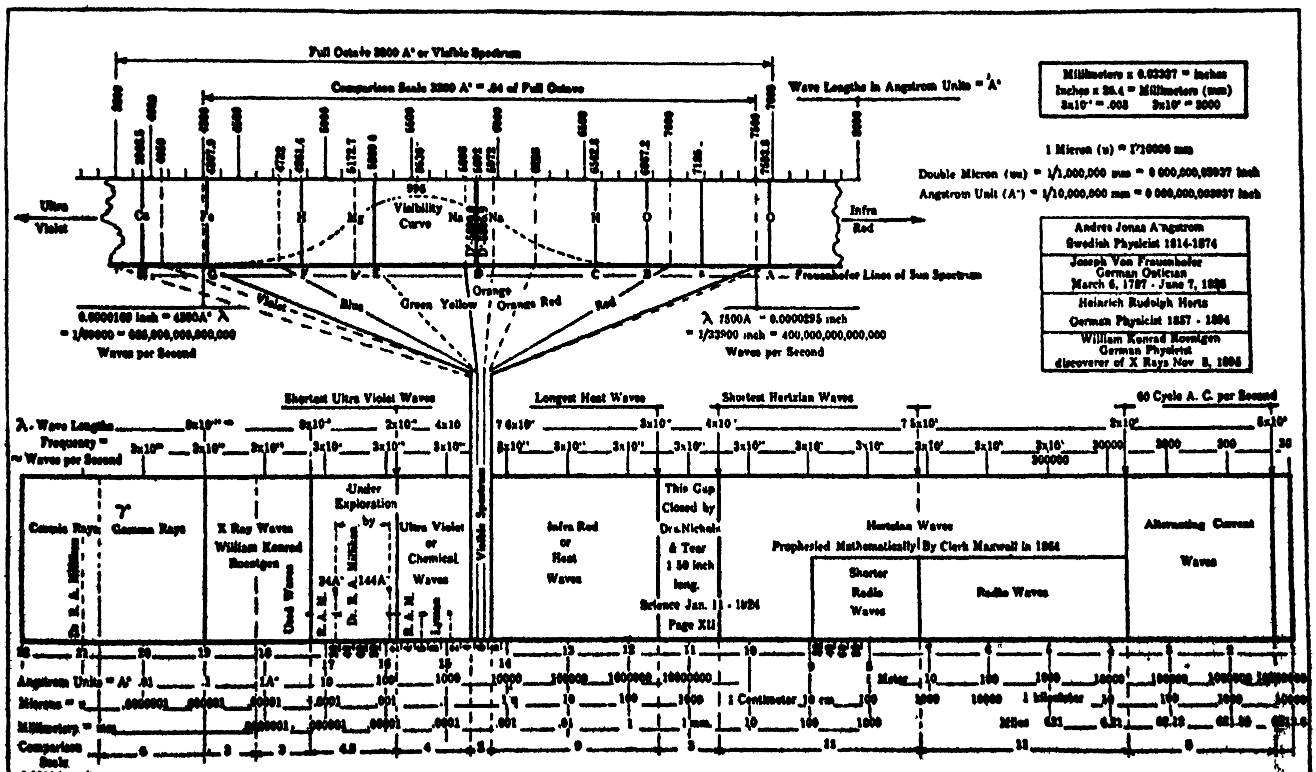
Among the many technical applications of high frequency oscillations and ultra-short waves, their use in radio transmission is the best known. Ultra-short waves are particularly well adapted for this purpose, because they can be focused and transmitted in the form of narrow beams of less than one square meter cross-section. Such a concentration of energy has two great advantages. In the first place no energy is wasted, inasmuch as it all arrives at the place of destination. Ultra-short waves are therefore very economical, in contradistinction to long waves, an overwhelming part of whose energy is wasted in space without ever being received. For example, by the use of waves of about 18 centimeters wavelength a radio telephone connection between France and England has been established with an energy output of only a small fraction of a watt.

SCIENTIFICALLY, ultra-short waves are used for the determination of many important properties of various kinds of matter. Every part of the electromagnetic spectrum can be used as a key to interpret the secrets of the structure of matter, and will reveal these secrets in its own characteristic manner. For example, from the emission, absorption, and scattering of gamma rays by a given substance much information can be deduced with respect to the constitution of the so-called atomic nuclei of this substance—or, in other words, the very heart of the atoms. Absorption and emission spectra in the regions of X rays, ultra-violet, and visible light have revealed to physicists the exact constitution of the atoms and molecules of all the most important substances. Finally the association or clustering of molecules—the constitution of ionic and neutral solutions, and so on—can effectively be studied with the help of ultra-short waves.

Recently, with the help of ultra-short waves, important results have been obtained with regard to what physicists call the problem of the solid state of matter. A very promising start in this direction has been made by Professor Potapenko and Dr. Sänger, working together at the California Institute of Technology. These investigations have thrown new light especially on the constitution of ferromagnetic substances, such as iron, nickel and cobalt, and new possibilities have been revealed for the use of these substances in the electrical industry.

While it is not possible here to give any more details about these fascinating researches, and while readers of this article who wish to obtain more information must be referred to the original publications in scientific journals,[1] it should be borne in mind that ultra-short waves are destined to become a universal tool in the hands of scientists and engineers.

[1] R. Sänger, Frequency Dependence of Superconductivity and Ferromagnetism. *Physical Review 44*, p 302, 1933 F. Zwicky, The Problem of the Solid State of Matter, *Mechanical Engineering*, July, 1933.



RANGE OF ELECTROMAGNETIC WAVES

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Valparaiso, Indiana

SPANNING SAN FRANCISCO BAY

RUNNING several months ahead on all schedules on the 75,000,000-dollar San Francisco-Oakland Bay Bridge, that will span San Francisco Bay between the two cities, contractors confidently expect to complete the structure by early spring of 1937.

Satisfactory progress also is being made on the 36,000,000-dollar Golden Gate Bridge,* spanning another but smaller part of San Francisco Bay.

Completion of the two bridges in 1937 will form the basis for a World's Exposition and Celebration for the Bay area.

Extensive soundings in the bay for pier foundations had been in progress for three years, and plans and specifications having been approved to meet every requirement of the Government and the Reconstruction Finance Corporation, the first contract for the San Francisco-Oakland Bay Bridge was awarded February 28, 1933.

Within 30 days, all of the sub-contracts were awarded and work started simultaneously on both sides of San Francisco Bay and on Yerba Buena Island, about mid-way in the Bay.

The San Francisco-Oakland Bay Bridge is to be a double deck structure $8\frac{1}{4}$ miles long from the end of its approach at Fifth and Harrison Streets in San Francisco to the end of its approach at Thirty-seventh and Market Streets in Oakland. The upper deck will be 58 feet wide and will carry six passenger automobiles abreast. The lower deck will carry three lanes of heavy trucks and two interurban car tracks. The bridge traffic will be limited to passenger automobiles, 40-ton trucks, and 70-ton interurban cars as a maximum tonnage.

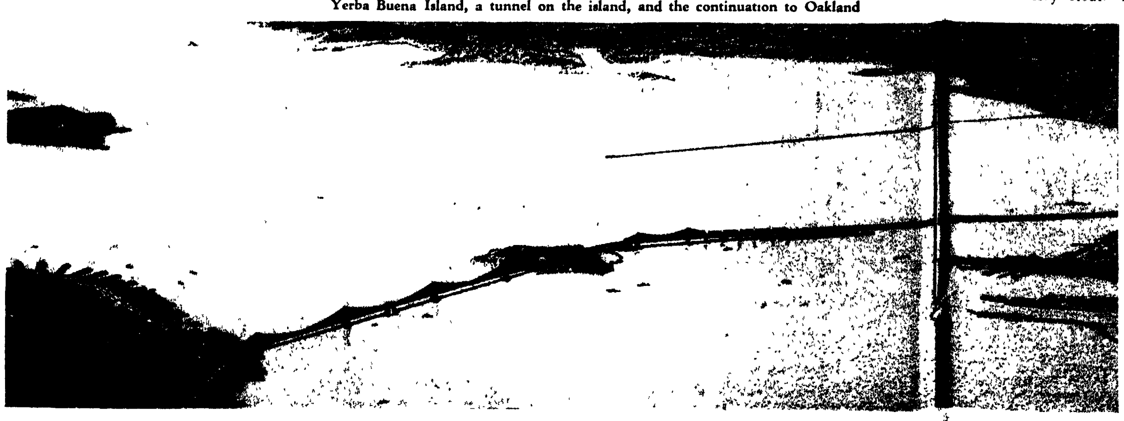
The concrete anchorage between the two suspension spans from San Francisco to Yerba Buena

The West Bay Crossing between Yerba Buena Island and San Francisco consists of a 10,450-foot suspension bridge with a center anchorage of concrete in the middle connecting the main suspension spans, which are each 2310 feet in length. All West Bay piers will be founded on rock, and will range in depth from 200 to 235 feet below the surface of the water. The height of towers will be from 465 to 505 feet. From the bottom of a concrete pier in the West Bay to the top of the tower will be more than 700 feet, or taller than a 70-story skyscraper. The area of the piers at water level will range from 52 by 122 feet to 92 by 197 feet.

THE center anchorage will be approximately 92 by 192 feet in area without fenders, at the water line, and will rise 298 feet above the surface of the water.

The cables supporting the suspension bridge will be 28 inches in diameter and will consist of 37 strands containing a total of 17,464 wires. These cables will be anchored in San Francisco in a giant block of concrete containing 68,000 cubic yards of cement and aggregates, and will be anchored on Yerba Buena Island in tunnels into solid rock and made fast by steel eyebars set in concrete. The pull on each cable will be about 37,000,000 pounds, both live and dead loads.

The Yerba Buena Island crossing will consist of a double-deck tunnel 540 feet long and 76 feet wide by 58 feet high, providing for six lanes of passenger automobile traffic on the upper deck and three lanes of trucks and two interurban cars on the lower deck. This tunnel will be lined with bright surfaced steel and will be the largest bore tunnel in the world.



From San Francisco on the left, the bridge consists of two suspension spans to Yerba Buena Island, a tunnel on the island, and the continuation to Oakland

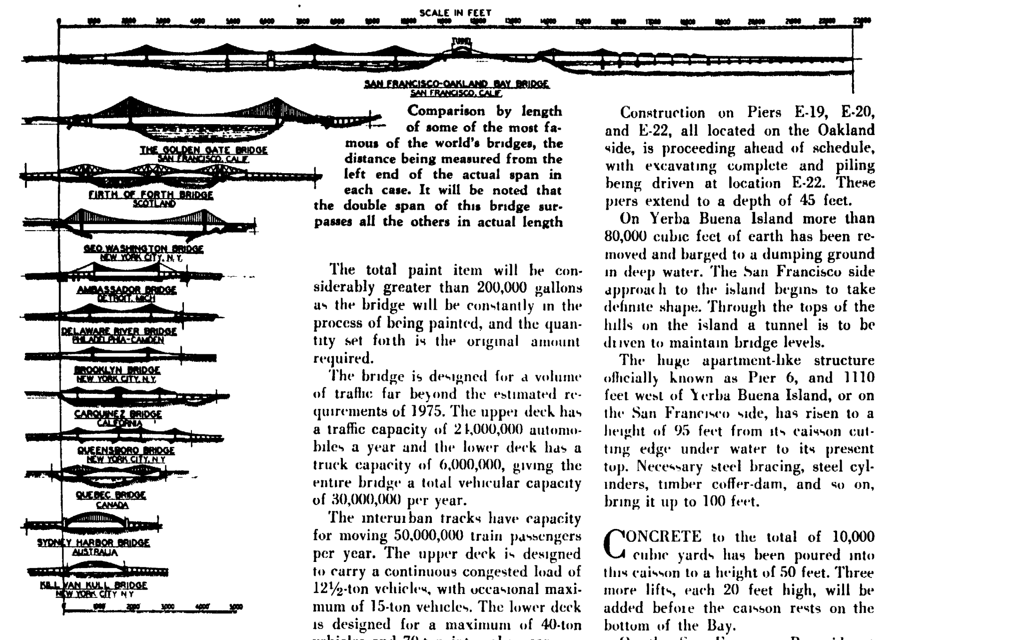
*An article on the Golden Gate Bridge is soon to be published—*The Editor*

The East Bay Crossing, between Yerba Buena Island and Oakland, will consist of one cantilever span 1400 feet long, five simple spans each more than 500 feet in length, and a mole supported by concrete and wood piles. This bridge will parallel, slightly to the north, the Key Route Mole, and will continue double deck to the toll plaza near the Oakland shore, where the bridge approach widens out to prevent congestion.

The clearance of the East Bay Crossing will be 185 feet above high water.

The steel required for the bridge will constitute approximately 6.7 percent of the estimated output of the United States last year.

The lumber will be equivalent to the quantity of lumber which would be required to build 3000 five-room homes, or the number of dwellings in a town of 15,000 population.



Comparison by length of some of the most famous of the world's bridges, the distance being measured from the left end of the actual span in each case. It will be noted that the double span of this bridge surpasses all the others in actual length

The total paint item will be considerably greater than 200,000 gallons as the bridge will be constantly in the process of being painted, and the quantity set forth is the original amount required.

The bridge is designed for a volume of traffic far beyond the estimated requirements of 1975. The upper deck has a traffic capacity of 24,000,000 automobiles a year and the lower deck has a truck capacity of 6,000,000, giving the entire bridge a total vehicular capacity of 30,000,000 per year.

The interurban tracks have capacity for moving 50,000,000 train passengers per year. The upper deck is designed to carry a continuous congested load of $12\frac{1}{2}$-ton vehicles, with occasional maximum of 15-ton vehicles. The lower deck is designed for a maximum of 40-ton vehicles and 70-ton interurban cars.

THE bridge will employ an average of 6500 men on location during its construction and will cause the employment of 5000 additional men in factories manufacturing materials for the bridge. At the outset of construction approximately 400 men were employed in actually building the bridge. This number will rise to a peak of approximately 12,300 men, and then decline gradually as the bridge approaches completion, giving an average of 6500 employed during construction.

The following figures cover progress of work on the Bay Bridge up to December 15, 1933: Employment on location work now totals 2100 men, with an additional 1200 men at work in steel mills. Bridge Builders, Inc., contractors for bridge foundations, are well along on the dredging on Pier E-5, 1000 feet west of the Key Route Mole, on the Oakland side. The cutting edge of the caisson is resting in the material at the bottom of the Bay and has only a few feet to go to its final anchorage.

Additional lifts of 20 feet have been placed on caisson at Pier E-4, 1500 feet west of the Mole, and the caisson cutting edge has been landed successfully 80 feet below the water surface and 40 feet into mud. The pouring of concrete has been going on rapidly and is now approximately 20 feet above the low water mark.

Construction on Piers E-19, E-20, and E-22, all located on the Oakland side, is proceeding ahead of schedule, with excavating complete and piling being driven at location E-22. These piers extend to a depth of 45 feet.

On Yerba Buena Island more than 80,000 cubic feet of earth has been removed and barged to a dumping ground in deep water. The San Francisco side approach to the island begins to take definite shape. Through the tops of the hills on the island a tunnel is to be driven to maintain bridge levels.

The huge apartment-like structure officially known as Pier 6, and 1110 feet west of Yerba Buena Island, or on the San Francisco side, has risen to a height of 95 feet from its caisson cutting edge under water to its present top. Necessary steel bracing, steel cylinders, timber coffer-dam, and so on, bring it up to 100 feet.

CONCRETE to the total of 10,000 cubic yards has been poured into this caisson to a height of 50 feet. Three more lifts, each 20 feet high, will be added before the caisson rests on the bottom of the Bay.

On the San Francisco Bay side at Pier 2, the concrete foundations have been completed. On these foundations will rest the enormous steel towers holding the bridge structure proper.

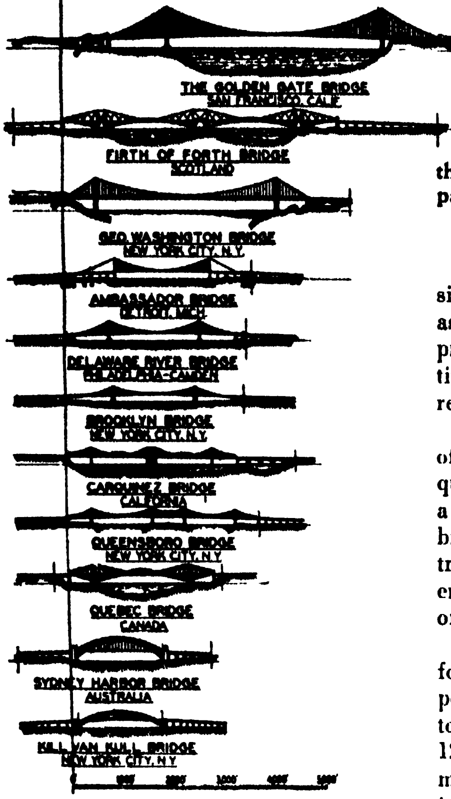
Caissons for Piers 3, 4, and 5, are ahead of production schedule at the Moore Dry Docks in Oakland. These are all for West Bay foundations.

Steel piling for Pier 1 on the east line of Spear Street in San Francisco is under construction by the Healy-Tibbetts Construction Company.

Approximately 18,000 cubic yards of concrete has been poured in the Rincon Hill anchorage on the San Francisco side, from which suspension bridge supporting cables will be anchored.

At Pier E-5, near the Key Route Mole, on the Oakland side, the contractors have placed approximately 12,000 cubic yards of concrete. The cutting edge of this caisson is now 113 feet below the surface of the water; the caisson stands 22 feet above the water line, or a total of 135 feet in height.

The San Francisco-Oakland Bay Bridge is being built under the California Toll Bridge Authority of which Governor James Rolph, Jr., is Chairman. Construction is supervised by the San Francisco-Oakland Bay Bridge Division of the Department of Public Works, of which Earl Lee Kelly is Director. C. H. Purcell, State Highway Engineer, is Chief Engineer in charge of the bridge.



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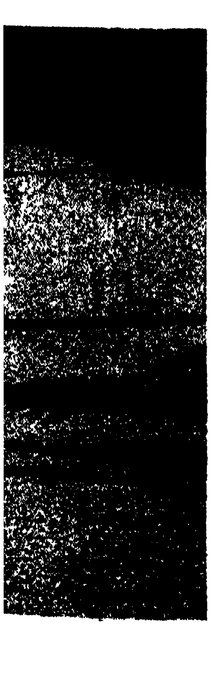

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Sundials and Their Construction—II

Determining a Meridian Line and the Declination of a Plane. Construction of the South Vertical Type of Dial

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M. A.
Research Assistant, Harvard College Observatory

IT is just as necessary to place a dial properly as it is to be meticulous in laying out the hour lines, for if care is not taken in placing the dial, regardless of the care taken in inscribing the lines, it will be of little use.

The 12 o'clock line on a sundial always lies in the plane of the meridian*. Therefore the meridian line of the place

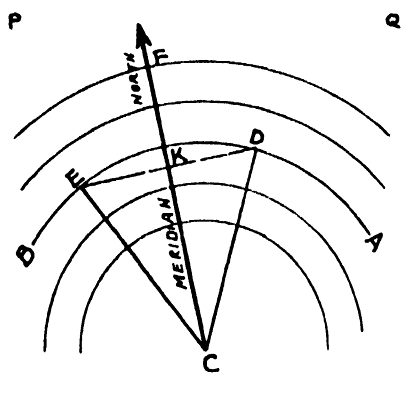


Figure 1

must be determined in one way or another. In the case of certain dials, such as vertical declining dials, the meridian line must be determined before the hour lines can be constructed.

The easiest way to set a dial is, first, to mark the meridian line on the top of its pedestal, or whatever the surface used to accommodate the dial, then produce the 12 o'clock line both ways to the edge of the dial plate and make faint marks at either extremity. Now place the dial on its pedestal so that the two marks made on the edge of the dial coincide with the meridian previously marked on the pedestal. After the dial has been leveled or plumbed carefully it will be in the position for which it was constructed.

*For definitions of "meridian" and other technical terms used in this article, see page 84, February, 1934, *Scientific American*—Editor

It is much easier to work in daylight than at night; therefore the following methods of finding the meridian have been selected because they depend upon the sun.

In Figure 1, the square *OPQR* represents a carefully leveled board. At any convenient place on the board mark the point *C*. With *C* as a center, describe several concentric circles. At *C* erect a pin perpendicular to the board, and long enough to cast a shadow on the circles. Some time during the morning the shadow cast by the top of the pin will touch one of these circles, as *AB*, at *E*. Mark this point carefully with a pencil. In the afternoon the shadow of the top of the pin will again touch the circle *AB*, at *D*. Mark this point carefully as before. Draw the line *ED* and find its middle point at *K*. From *C*, through *K*, draw the line *CF*. This will be the true meridian line for the place.

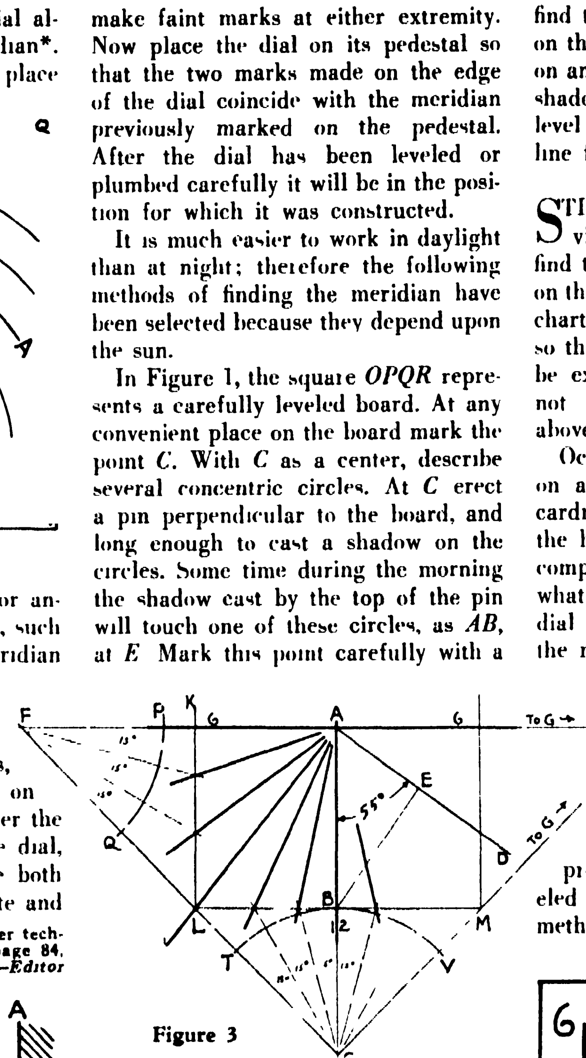


Figure 3

Another convenient method, and one that consumes a minimum amount of time to accomplish, is by using the accompanying chart, which shows the relation between apparent noon (at which time the sun is on the meridian every day) and mean time (the time shown by the clock). From the chart, find the time at which the sun will be on the meridian at any given place and on any particular day. At that time the shadow cast by a plumb line on a flat level surface will show the true meridian line for that place.

STILL another method: Having previously leveled or plumbed the dial, find the time at which the sun will be on the meridian, from the accompanying chart; and at that time orient the dial so that the time shown by the dial will be exactly 12 o'clock. This method is not so accurate as those described above.

Occasion may arise to place a dial on a surface that does not face the cardinal points of the compass. Before the hour lines for such a dial can be computed it is necessary to know at what angle the plane, upon which the dial is to be inscribed, declines from the meridian.

The accuracy of the dial depends upon the care used in determining the angle of declination. In Figure 2, *AB* represents one side of a wall upon which it is desired to place a vertical dial. The board *OPQR* is pressed firmly against *AB* and leveled carefully. By one of the foregoing methods draw the meridian line *NS*.

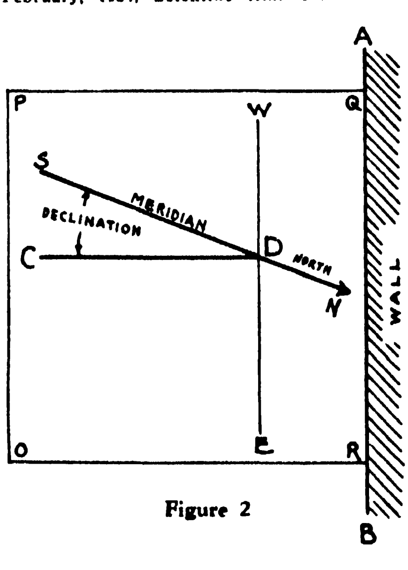


Figure 2

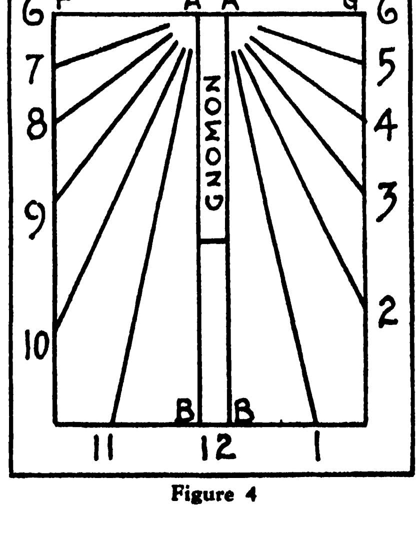


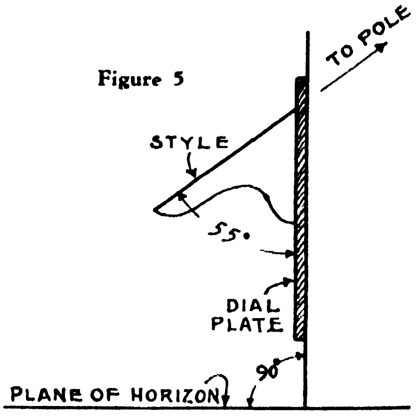
Figure 4

Then draw the line *EW*, parallel to *AB*, cutting *NS* at *D*. From *D* draw the line *DC*, perpendicular to *EW*. The angle *CDS* is the declination of the plane upon which the dial is to be placed, and *CDS* is also the declination of the dial. In the diagram, the wall faces the south and declines east. The declining dial will be described in a future article.

The plane of the direct south vertical dial is perpendicular to the plane of the horizon, and faces due south. Figure 3 shows the construction of the hour lines for latitude 35°.

The style points to the celestial pole. The substile is the 12 o'clock line and lies in the plane of the meridian. The height of the style is equal to the complement of the latitude, which in this case is 55° (90°−35° = 55°).

Figure 5



Draw the horizontal line *FA* (this will be the 6 o'clock line).

At *A* draw *AC* perpendicular to *FA* (this will be the 12 o'clock line).

Draw *AD* so that the angle *CAD* is equal to the height of the style, or 55°.

From *B*, on *AC*, draw *BE* perpendicular to *AD*.

Make *BC* equal to *BE*; then make *AF* equal to *AC*.

Draw the line *FC*. Through *B* draw a line parallel to *FA*, cutting *FC* at *L*. Through *L* draw the line *LK* parallel to *AC*.

With radius *BC* and centers at *C* and *F*, describe the arcs *TV* and *PQ*. Divide these arcs into equal parts of 15° each. Draw lines from *F* and *C* through the points thus found, until they cut the lines *LK* and *LB*, respectively.

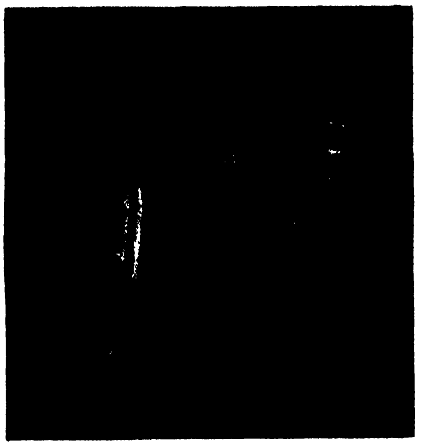
Draw lines from *A* through the points found on *LK* and *LB*. Also draw a line from *A* through the point *L*. These lines will be those required for the morning hours.

To obtain the afternoon hour lines, extend the line *FA* to *G*, making *AG* equal to *AC*. Draw *CG* and continue the construction as shown above.

Figure 4 shows the hour lines transferred to the dial plate, and the way in which they should be numbered.

Figure 5 shows the position of the dial when in use.

The sun will not shine upon this dial before 6 in the morning nor after 6 at



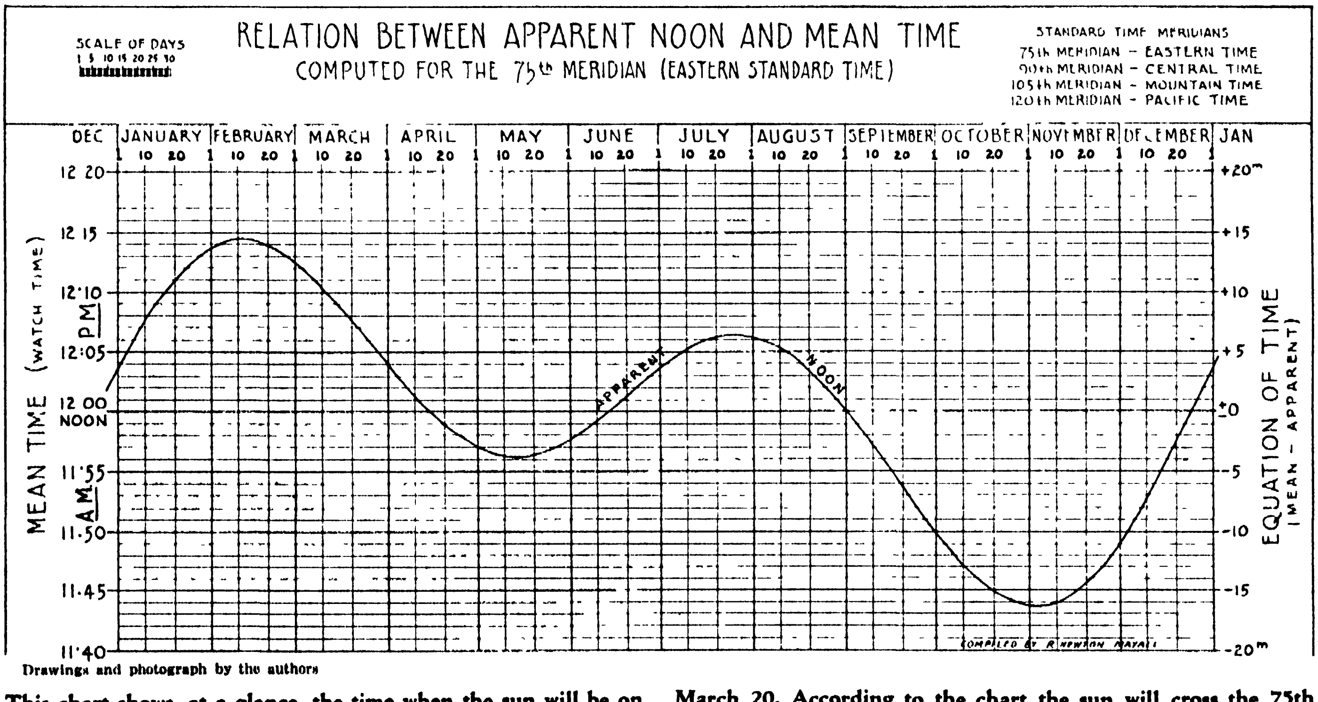
Vertical type of dial on side wall of dormitory, Mt. Holyoke College

night; therefore it is necessary to show only the hours between 6 A.M. and 6 P.M.

This dial must be placed in a perfectly vertical position, so that the 12 o'clock line will lie in the plane of the meridian, and the plane of the dial will face due south, or in the plane of the prime vertical.

●

The next article will describe the construction of the north, east, and west vertical dials, and the polar dial There will be at least three more articles, dealing with declining dials, the materials of construction and so on.



Drawings and photograph by the authors

This chart shows, at a glance, the time when the sun will be on the standard meridian (at the left), and the equation of time (at the right), for any day in the year. A correction will have to be made for the observer's meridian, if his meridian is east or west of the standard meridian for the time zone in which he is stationed. This correction amounts to four minutes for each degree of longitude east or west of the standard meridian. If the observer's meridian is east of the standard meridian, the correction must be subtracted from the time shown on the chart; if west, the correction must be added. *Example:* Find the time the sun will be on the meridian at Boston, Mass., on March 20. According to the chart the sun will cross the 75th meridian at 12h 7.5m P.M. E.S.T. The longitude of Boston is 71.07 degrees. The difference between Boston and the standard meridian (75th) is 3.93 degrees. Applying the correction of four minutes for each degree of difference, 15.7 minutes must be subtracted from the time obtained from the chart, since Boston is east of the standard meridian. Therefore the sun would be on the meridian at Boston, March 20, at 11h 51.8m A.M. E.S.T. Note that the equation of time is equal to the mean time minus the apparent time. This chart is applicable to the standard meridians (see upper right hand corner)

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

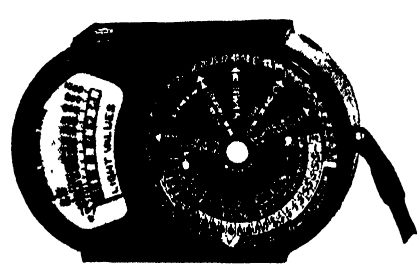
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

Perfect Exposures

CORRECT exposure is one of the vital problems of good photography. So many factors enter into proper exposure that even those of long experience, who pride themselves on their picture results freely admit their inability consistently to judge photographic light under all conditions. Now seasoned photographers no longer rely on their personal judgment of light values, but are able to devote all of their attention to composition. They determine exposures the modern and positive way with a Weston Exposure Meter.

The untiring "electric eye" in the exposure meter never guesses. It properly gages the photographic light regardless of whether exposures are made in sunlight or deep shade, in various climes, or in mountainous country. Thus film wastage is eliminated and disappointment over the loss of prized pictures is a thing of the past.



A photo-cell exposure meter

Miniature camera owners will find this exposure meter an invaluable aid in obtaining uniformly high-grade negatives—negatives that will be worthy of enlargement expense. For the motion picture enthusiast an exposure meter is indispensable. It not only eliminates film spoilage, but assures a uniformity of film that brings complete satisfaction when projected on the screen.

New Treatment of Radium Poisoning

FUTURE sufferers from radium poisoning may have hope for recovery by a method now being developed by Robley D. Evans, physicist of the University of California and Dr. R. Ware of the Los Angeles General Hospital.

These investigators are now trying it out on the few survivors of the unfortunate luminous dial paint workers of 10 or more years ago, and so far the results are promising. Since radium workers in mines and in laboratories will always be exposed to the dangers of this dread form of poisoning, development of a successful method of treatment is much needed.

The method follows the work of Dr. J. C. Aub, Prof. F. B. Flinn, and Dr. S. M. Seidlin and depends on the fact that calcium and radium are very similar in chemical properties. The calcium absorbed by the body goes mainly into the bony structure and therefore the radium also accumulates there. Since the bones are comparatively permanent in composition the radium remains in place, giving off radiations which wreak destruction on the blood-producing centers as well as on the surrounding bone structure.

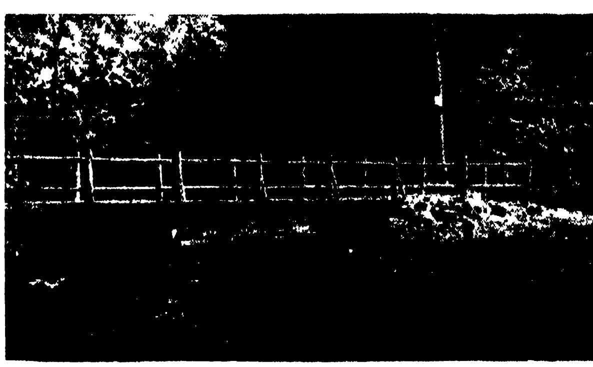
Now an excess of parathyroid gland hormone will disturb the normal calcium metabolism, causing the system to lose an excess of calcium. Consequently it ought to eject radium too. Of course, after this depletion of the calcium has gone far enough the diet must be made rich in calcium to give the bones a chance to regain their proper strength.

Essentially the process is a rinsing out of the radium-contaminated calcium and a substitution of fresh pure calcium. It is a drastic treatment.

To date it has speeded up the rate of elimination of radium to three times the normal rate. This is not yet enough to save the life of a victim, but information gained in these experiments has made possible a modified treatment which it is hoped may at least lengthen the remaining life span for those victims who have had radium poisoning for a decade or more.—*Science Service.*

"Soft" Milk

COMING generations of babies may be spared stomach aches and their parents spared dreary hours of floor-walking, if the discoveries of Lyman, Browne, and Otting, reported in *Industrial and Engineering Chemistry*, bear fruit. These three chemists conceived the idea of putting cows' milk through a regular water-softening plant, such as many factories use to prevent scale from forming in boiler tubes. They found



Left: **A properly exposed photograph, the timing of which was determined by the exposure meter described in these columns**

Right: **The same scene as the one above, but improperly exposed as a result of determining time "by the eye"**

that this softening process made cows' milk very much easier on baby's stomach, because it removed some of the calcium naturally present and thus resulted in the formation of a soft, flaky curd in baby's stomach instead of the hard, dense curd which often causes baby's discomfort

It was found that an ordinary zeolite water-softener would remove about 20 percent of the calcium present in milk, provided the milk was slightly acidified before processing. Milk thus modified curdles in the stomach in small, flocculent granules which digest rapidly. The sponsors of this process state that the appearance and taste of the milk are not appreciably altered by the zeolite treatment *A E B*

American Grub Now Kills Snakes

CACTOBLASTIS cactorum, the little imported American grub that has reclaimed more than 3,000,000 acres of prickly-pear-infested land in northeastern Australia by the simple process of eating down the pear and killing the roots, is winning additional fame in some districts as the slayer of the Queensland adder.

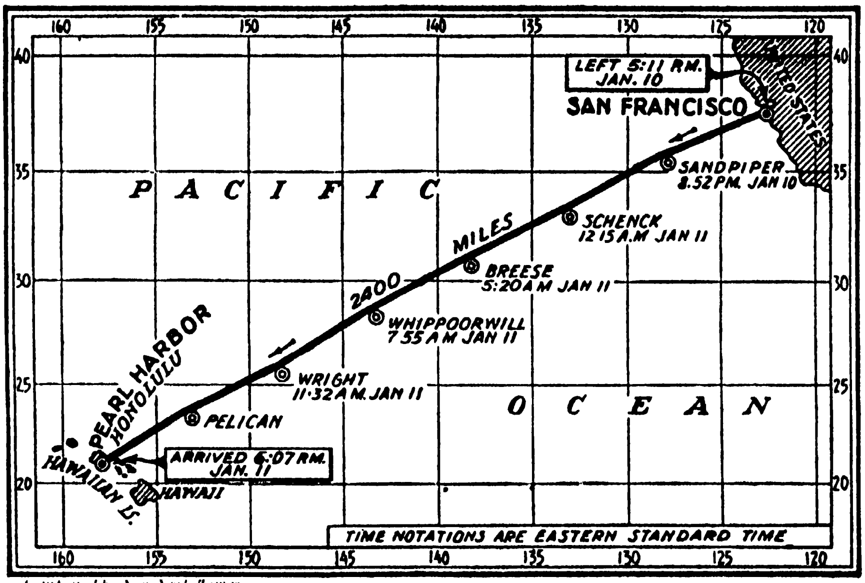
The adder, regarding the grub as a pest, eats it and dies from its meal. It is passing with the pear at a surprising rate

One explanation is that the adder's motive for eating the cactoblastis is not hunger, but revenge. The destruction of the prickly pear cactus is robbing the snake of his shelter, and he regards the grub as nothing less than a home wrecker. The loss of his shelter has probably made the adder an open mark to emus and other birds which prey on his young and on the eggs.

Fruit Ice Creams Improved

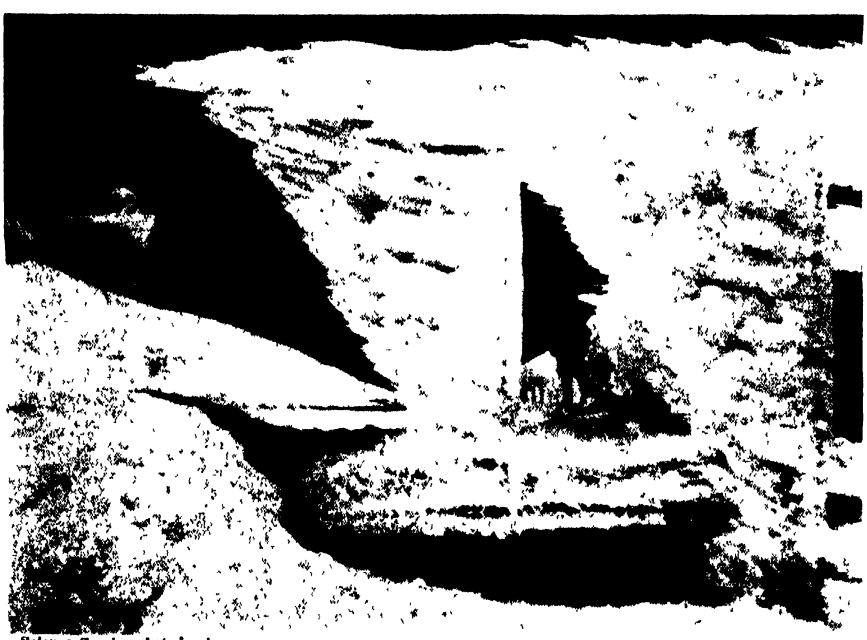
THE familiar chunk of ice that almost always marks each bit of strawberry or peach or whatever it may be that is used in fruit ice creams will be a thing of the past when a new method of handling the fruit used in frozen desserts is generally adopted by ice cream manufacturers. The process, developed by dairy specialists at the State Experiment Station at Geneva, New York, involves the freezing of the fruit in a syrup at a very low temperature, followed by soaking for a short period in the syrup after thawing before incorporation in the ice cream mix. Fruit treated in this way does not freeze any harder than the ice cream itself, as the freezing point is lowered by the sugar which penetrates into the fruit.

The Experiment Station has just issued a bulletin describing the process and reporting on tests of the new method in the Station dairy laboratory. It is entitled, "Frozen Fruits for Ice Cream" and has been prepared by Prof J. C. Hening and Dr. A. C. Dahlberg. In addition to the experimental work, the bulletin gives directions for making fruit ice creams on a commercial scale.



Courtesy *The New York Times*

A routine performance in the line of duty, was the way Lieut. Commander Knefler McGinnis characterized the flight of six Navy planes from San Francisco to Honolulu, January 11, 1934. Without mishap the planes flew along the course, shown on the map above, which was patrolled by the naval vessels noted. The total time of the flight was 24 hours and 56 minutes for a distance of 2400 miles. The aviators encountered fog, but maintained their schedule



Science Service photograph

A typical formation of frost "feathers," more common on Mt. Washington than anywhere else in the country, is shown in the above photograph. These "feathers" built out three feet in 12 hours at 10 degrees above zero. Strangely, the formation "grows" into the wind, the wind blowing left to right in photo

Artificial Marble

IMITATION marble is now being manufactured by a patented process described in *Solvent News*. An exact likeness to a real marble slab is first obtained on a photographic film by the use of color filters. The design is then transferred to a transparent cellulose plastic compound in sheet form This, in turn, is colored to give opaque and translucent effects as desired, and finally laminated between two pieces of glass.

The resulting product looks exactly like the original marble but has the advantage of greater durability, is more easily cleaned and can be perfectly "booked" or matched in graining, ordinarily a long and expensive process where quarried marble is used. —*A. E. B.*

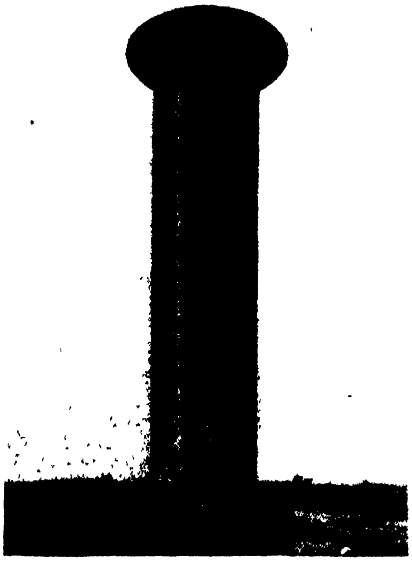
Setting the Clock Back to Tomorrow

ENORMOUS disks, spinning at high speed in an almost perfect vacuum, will replace the familiar generators and motors of modern electrical plants. Thus Dr. R. J. Van de Graaff, brilliant young physicist of the Massachusetts Institute of Technology, prophesied before the recent meeting of the British Association for the Advancement of Science at Leicester, England.

These disks would be great electro-static machines, producing direct current electricity at tremendously high voltage. The vacuum would be necessary in order to prevent the production of tremendous sparks that might wreck the whole machine and would in any case prevent the electricity from being led out on wires to be usefully employed. Dr. Van de Graaff believes that vacua sufficiently high to insulate the machines against such electrical breakdown

can be produced, even in the large housings that would be required for the industrial production of current by electro-static machines. He exhibited designs for such machinery.

If Dr. Van de Graaff's prophecy is realized, it will be, in a sense, progress made by setting the clock back. For the electrical machines that were used by the 18th Century school of "natural philosophers" of which our own Dr. Benjamin Franklin was a brilliant member, were all of the electrostatic type. They generated electricity by friction on large disks. Instruments of the same kind are still used for special purposes in laboratories.



One of the Madaras rotors, showing corrugated shell and cap at the top

The trouble with such machines has always been that the air was not a sufficient insulator to prevent sparks, after a certain potential had been built up. For this reason the development of the electric age had to await the discovery that electricity could be generated in another way, by moving a conductor in the field of a magnet. All our present generators are elaborate arrangements of magnets, past which systems of wire coils are rapidly moved, with arrangements for capturing and leading off the current thus produced. They are the best we have; but their working efficiency is admittedly not as high as could be attained, at least in theory, by properly arranged and insulated electro-static machines. Dr. Van de Graaff believes that such theoretically possible machines can actually be built. (See also article on page 132.—*Ed.*)

Dr. Van de Graaff has attracted much attention among physicists by the simple but tremendously impressive electro-static machines he has already built, first at Princeton and latterly at the Massachusetts Institute of Technology. These have produced "artificial lightning" measured in hundreds of thousands of volts, used in atom-smashing experiments.—*Science Service.*

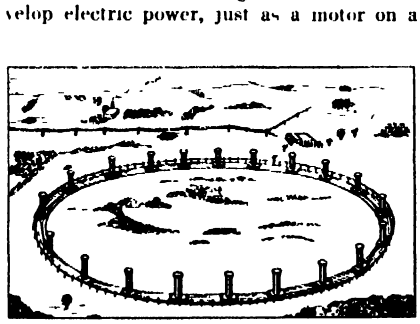
Fiber Pan Improves Pies

PAPER pie plates are no novelty, but heretofore they have been used only after the pie is baked. Nothing had been found to take the place in the oven of the old-fashioned tin pie-pan until a treated fiber board pan made its appearance recently. The fiber board is impregnated with titanium oxide, making it resistant to oven temperatures. This new style pie-pan is finding a ready sale to bakers of pies who can put their wares through their ovens in these fiber pans which, it is claimed, help produce as dry and flaky a crust on the bottom as on the top of the pie.—*A. E. B.*

Madaras Rotor Power Plant

INTERESTING experiments have recently been made at Burlington, New Jersey, on one unit of a rotor power plant, the ingenious invention of Julius D. Madaras.

The rotor power plant, as shown in the artist's diagram, is to consist of a number of large cylinders—each 90 feet high and 22 feet in diameter. These units, when turned about on their own axes in a wind, generate a large lateral force by what is known as the Magnus Effect. This force is many times greater on the spinning cylinder than on the same cylinder at rest in a wind. Each spinning cylinder is mounted on a car or truck which travels on a circular track. By properly adjusting the revolutions of the cylinder to the speed of the wind, a great tractive effort will be exerted, driving the whole system round and round the track, with appropriate reversal of the cylinder in rotation when changing its direction of travel relative to the wind. Each car will carry a large electric generator geared to the wheels. As the wind pushes against the spinning cylinder and moves the car along the track, the wheels will drive the generator and develop electric power, just as a motor on a street car running down-hill acts as a generator and feeds electric power into the line.



An artist's drawing of the set-up of a Madaras rotor power plant

On a track one half mile in diameter, 40 rotors would be required and 50,000 kilowatts would be available in electric energy. It is claimed by the inventor, and his calculations have been checked up by public utility experts, that the cost of power will average far less than the average cost with either a steam or a hydro-electric plant.

Of course, a great many mechanical and electric problems remain to be solved, but the project is one of importance.

One of our photographs shows a rotor as it is set up at Burlington, New Jersey, with corrugated outer shell, and the top capped. Another shows the huge internal tower on which the outer shell rotates with a minimum of friction. The outer shell is driven by a large steel shaft, running from the very bottom of the structure. While the shell is of corrugated dural, the internal structure of the tube is of welded steel.

Coefficients of pressure on the tower have been obtained by coordinating the indications of four thrust dynamometers at the base of the rotor with the readings of a number of anemometers placed on towers at strategic points.

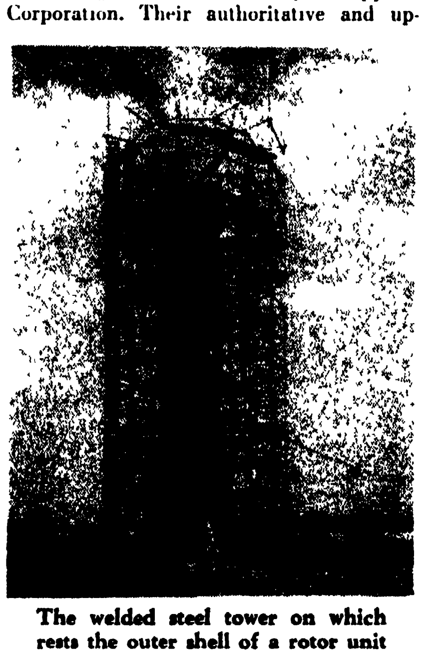
The next step will be the construction of a complete rotor plant somewhere where the wind is steady and appreciable in magnitude. These experiments are being very carefully watched by aerodynamicists and electric power executives and technicians.—*A. K.*

Danger on the Ground

CHARLES DOLLFUS, Curator of a French aeronautical museum, a balloonist and an expert on lighter-than-air craft, has flown thousands of miles in airships and crossed the Atlantic on the *Graf Zeppelin* in its trip to the Chicago Century of Progress. Arrived at Chicago, he took a ride in a new three-wheeled streamlined car, which turned over in a bad accident. M. Dollfus has only recently emerged from the hospital. Joining in the discussion of the papers (reviewed in the following paragraphs) by Dr. Arnstein and Commander Fulton, he pointed out that engineers were too prone to think mechanical equipment alone could ensure safety in transportation. In the case of airship navigation, M. Dollfus stressed the immense importance of personnel. Thus, on the *Graf Zeppelin*, each man takes only a four hour shift, and there are three men to every man really required. It is true that this superabundance of crew means loss of payload, but what a record this system of plenty of hands and generous relief for men on duty has earned for Dr. Eckener in the *Graf Zeppelin!*—*A. K.*

Airship Progress

THE American Society of Mechanical Engineers recently had the privilege of hearing two eminent airship men lecture to its members: Commander Garland Fulton, of the Bureau of Aeronautics, Navy Department, and Dr. Karl Arnstein, Chief Engineer of the Goodyear-Zeppelin Corporation. Their authoritative and up-



The welded steel tower on which rests the outer shell of a rotor unit

to-date papers were so closely allied that our readers may prefer a joint review.

The most important improvements in performance of future airships will come through developments in the power plants. Since in an airship thrust must be not only reversible, but also applicable in an upward direction (for complete flexibility in maneuvering, particularly near the ground) the airship's power plant is considerably more complicated than that of the airplane. Again, the long cruising range of the airship necessitates complete reliability. No wonder that the power-plant weight of existing airships is abnormally high and that is why the greatest room for improvement exists in the power plant.

Airship engines hitherto have been of the water-cooled type. There is no reason why they should not be air-cooled, but arrangements for internal mounting and for the reversing and tilting propeller may be somewhat cumbersome for air-cooled engines.

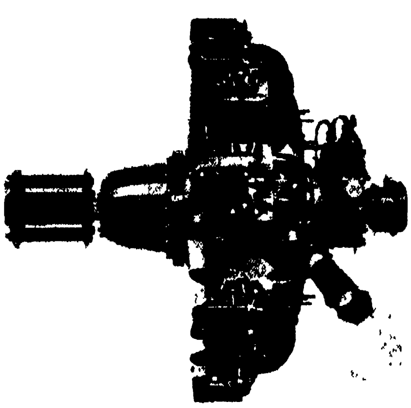
It is highly desirable to use a heavy fuel-oil engine in airship work, to decrease fire hazard and reduce fuel consumption. Efforts to obtain a light-weight compression-ignition engine to burn heavy fuel have not been entirely successful as yet, but the British engine described below holds great promise. Recent work on safety fuels, usable in the ordinary spark-ignited internal-combustion engines, yet having a flash point of about 115 degrees Fahrenheit, is very promising.

An airship must always be in approximate static balance for efficient navigation. As fuel is consumed this balance is broken and compensation is made by condensing the water in the exhaust gases. Such "water ballast recovery" means large radiators of considerable resistance and hence a loss in speed, and also weight and complication. The most likely method for supplanting the water ballast recovery system is the possibility of using "hydrogen ballast"; that is, burning hydrogen from the gas bags in the engines. With hydrogen as a fuel, consumption of fuel could be exactly balanced by the decreased content and buoyancy of the gas cells. Engines and carbureters functioning with hydrogen are perfectly feasible, but there is then risk of fire. It is now proposed to combine the good features of both helium-inflated and hydrogen-inflated airships by carrying hydrogen in interior ballonets or bags completely surrounded by helium. This scheme will permit higher lifts, fuller initial inflations, reduced dead weight, and lower drag. It is most gratifying to learn that the Navy is now trying out this plan on a comparatively small non-rigid airship of 300,000 cubic feet.

The public is inclined to be contemptuous of the speed of the airship. There are very good reasons why airship speeds can not be suddenly jumped from the present speeds of 80 to 85 miles per hour, to the much better sounding 100 miles per hour. To overcome the added drag at high speed means more power plant and hence weight. But what is equally serious is that to withstand the pressures of high speed, the structure must be made much stronger and heavier. In fact it is quite possible that rigid airships of the fabric covered type are unsuitable for high speeds. Rather, the added strength may have to come from an airship with a thin metal covering, placed under tension by internal pressure—in other words, the metal clad type which we have had occasion to describe in these columns.—*A. K.*

A British Compression-Ignition Engine

AFTER five years of research on single cylinder units, the Bristol Aeroplane Company has produced a compression-ignition engine, the Phoenix, working on the four cycle principle, and developing 350 horsepower in its nine cylinders. The net dry weight is 990 pounds, which is not excessive for an engine of this type, employing ordinary commercial heavy fuel.



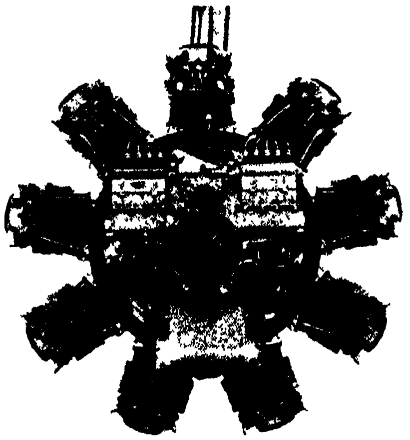
Side view of a Phoenix engine, indicating placement of accessories

Tests both on the motor dynamometer and in flight have been satisfactory.

This information and three pictures are all that the British Air Ministry has released to-date.

Will our readers look at the photographs of the engine and join us in guessing?

There is no carbureter and there is a two-way pipe at the rear of the engine, with what looks like a throttle lever at its side. The rear view of the engine looks as if there was a good deal more than an ordinary crankcase involved. Our guess is that air is drawn in through the pipe and considerably compressed in a compressor built right into the engine. From this compressor the air at high pressure is drawn through induction pipes to each cylinder.



Rear of Phoenix engine; compressors for fuel are above center line

The fuel is evidently drawn into small reciprocating compressors. From this fuel pump or compressor bank the fuel is led through a narrow pipe into each cylinder and presumably admitted at just the right point of the stroke. The fuel, mixing with the high compression air charge, is self-igniting. Each cylinder has four valves, two inlet and two exhaust. The cycle is the ordinary four-cycle intake at high pressure, further compression in the cylinder, instantaneous admission of the fuel, compression-ignition, working stroke and then exhaust. If our hypotheses are wrong, we shall learn in a few months. The main point is that a practical compression-ignition engine for aircraft use is now available.—*A. K.*

The British compression-ignition engine installed in a Westland "Wapiti"

Continual Watchfulness

ON a recent visit to Newark Airport, New Jersey, we noted that the operations managers of the various airlines all wore a watchful, slightly worried air.

Mr. Richard W. Robbins, President of Transcontinental & Western Air, an airline operator who is making a great reputation for himself, explains this strain by an interesting story. Operators are constantly in touch with the various planes of their systems by means of two-way radio telephone. Generally this is helpful. It is better to know than to wonder whether something is wrong. Sometimes even the two-way radio fails to bring peace of mind. Thus, at one time during the night, Mr. Robbins received a message to the effect

Sleeping berths installed in an Eastern Air Transport plane

that a pilot had lost a cylinder from his engine. The next message was to the effect that the plane was in flames. Nothing more was heard for six hours! Fortunately this was a plane being ferried from one airport to another without passengers. The pilot, a tenacious and plucky man, would not leave his ship until every hope of saving it had gone. He "bailed out" only at the last moment and landed in isolated territory from which he could send no message.

The pilot reported that a great peace came over him as he left the burning ship and sailed down calmly through space. To see the ship fall ablaze through the sky was an awe-inspiring sight.

If operators have to think of these things, it is no wonder they look worried sometimes. It is because they worry that air travel is so safe.—*A. K.*

Ozone Causes Gas Engine Knock

OZONE is an exceptionally active form of oxygen. The idea of feeding ozone to the carbureter of an automobile engine in order to produce quicker and more complete combustion has been suggested often. But recent research by the Bureau of Standards discourages this scheme, for it has been found that ozone is more potent in causing detonation, or "fuel knock," than tetra-ethyl lead is in suppressing it. As little as .002 of 1 percent will cause an increase in detonation equal to that occasioned by substituting regular gasoline for premium gasoline. By using somewhat higher concentrations—up to .01 of 1 percent—regular and premium gasolines were made to knock as badly as does kerosene. These concentrations of ozone, however, had no effect on power or efficiency when the compression of the engine was such that no detonation occurred.

While the average motorist is more interested in suppressing detonation than in obtaining it, and while stratosphere flights are still too far in the future to cause concern over the possible effect of ozone on the engines used in that region, this discovery gives automotive and petroleum technologists a new tool with which to study detonation and to test theories. As ozone and tetra-ethyl lead have opposite effects of the same order of magnitude, a study of the action of ozone may throw light on the mechanism whereby tetra-ethyl lead suppresses detonation.—*A. E. B.*

A Built-in Passenger Gang Plank

ON one of the latest Pitcairn Autogiros, a built-in step ladder or gang plank has been provided which makes passengers independent of portable ladders for entry into the cabin.

***Above:* The built-in passenger gang-plank on an Autogiro partly withdrawn from its housing. *Below:* The ladder fully extended for use**

Normally the ladder is entirely concealed in the fixed wing of the autogiro. When the ladder is thus telescoped into the wing, a steel spring clip holds it in place. To use the ladder it is only necessary to reach into a small slot in the under-surface of the wing, unlatch the spring, pull the ladder out to its full length, and then let it fall to the ground. Reversing the process is equally simple. The ladder is made of welded chrome-molybdenum tubing for lightness and strength.—*A. K.*

Sleeping in Flight

EASTERN Air Transport now offers sleeper berths on its run between New York and Atlanta, in the large Curtiss-Condor planes. The interior of the transport plane certainly resembles a Pullman sleeper in our photograph! The length of each berth is six feet five inches; the width is two feet four inches. Steel tubing, so current in airplane practice, is used for the construction of the berths, which can be taken down or made up with ease.

Reading lights, call buttons, Pullman-type draw curtains, clothes hangers, clothing nets, sheets, blankets, and pillows add to the comforts of life. There are individual ventilators, regulated at will in both upper and lower berths. It has been customary to complain of the discomforts of Pullman sleeper travel, and to say how nice it was to avoid them by flying! Now the same complaints will be made of the airplane. The only difference is that instead of three or four sleeper nights across the continent one will be the limit of "torture" for the air traveler.—*A. K.*

Fireproofing Airplanes

AS a general rule we make it a point to exclude from these columns any accounts of chemical developments unless we are able to obtain full technical details and to verify the scientific accuracy of the information. This policy is necessary to protect our readers against the many pseudo-scientific reports of a sensational character that frequently find their way into the non-technical press. If such chemical "quackery" appears to be harmless, we ignore it; if it seems to threaten to mislead the public in a dangerous direction, we expose it.

We are tempted to make an exception to this policy, however, to report what seems to be a promising discovery by an officer in the Belgian Aviation Reserve Corps—a system of rendering airplanes fireproof. The reports of his experiments seem to be authentic and although the chemical details of his invention have not been revealed, it is quite likely that this reticence is due to a desire to preserve a military secret.

The inventor gave the following explanations to an eye witness of his experiment: "My device consists of partitions, screens, or panels which contain chemical products with the property of resisting, not only the effects of flames of a fire, but also the heat intensity of a brazier, no matter what the nature of the generator producing the flame and heat. Among other properties, this device fails to give off any chemical emanations which are either toxic or merely disagreeable."

The inventor has given no details relative to the nature of the product or products employed. It is known that these "anti-fire"

and "anti-heat" substances are not metallic or of wooden base. They appear in the form of rigid plates which are not very thick. The inventor asserts that their weight per square meter "remains within the limits set for materials to be used in airplane construction." The following results illustrate the first tests carried out: an airplane hood covered with the new product was placed near a fire which gave out heat of 1100 to 1300 degrees, Centigrade. The hood contained a gasoline tank, a metallic mail box, and the inventor. Container and contents suffered in no way from the heat. —*A. E. B.*

Pin Worms Exonerated

THE lowly pin worm, which both popular and medical opinion has blamed as a cause of appendicitis, is seldom if ever responsible for this trouble, except in most exceptional cases. This conclusion is stated after an examination of 26,051 surgically removed appendixes by Dr. Harold Gordon, of the University of Michigan Pathology Department, in an article in the *Archives of Pathology*.

Some authorities have held in the past that pin worms, finding their way into the appendix, irritated the walls of the organ, making openings for the entrance of inflammation producing germs. In all his thousands of cases, Dr. Gordon found the parasites present in only 311, and of this number, only 12 showed any injury to the delicate mucous membrane inside the organ. Even these cases did not show that germ infection had followed at the point of the lesions.

Although pin worms are not a cause of appendicitis, infection of the organ with the parasites has increased in recent years, probably due to the increased eating of uncooked vegetables and fruits, Dr. Gordon found. In 20,969 appendixes examined up to 1931, the "oxy-urids" were present in 1.04 percent of all, while, with the addition of 5082 specimens since, the percentage has risen to 1.19. The earliest specimens, running back to 1894, showed the smallest percentage of pin worm infection. Since the modern diet is generally better for health than the old, however, and since the worms do little or no harm, the increased occurrence of the parasites means little and could easily be reduced by careful washing of fresh foods, Dr. Gordon believes. Infestation is most common in the first decade of life and practically unknown after the age of 46 in Michigan, he found.

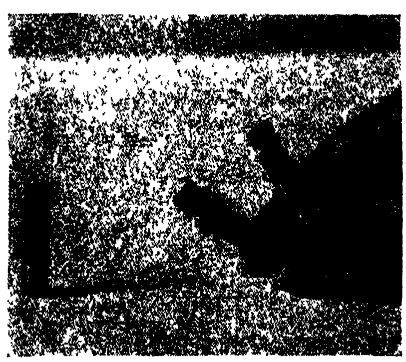
Water Erodes Steel

WATER jets cutting, or eroding, the edges of test pieces of the hardest steel in a few minutes are a feature of a test carried out by the Westinghouse Electric and Manufacturing Company. The test pieces, small but solid, are screwed into diametrically opposite points in the rim of a disk which may be revolved at many thousands of revolutions per minute so that the test pieces cut through the fine jet of water.

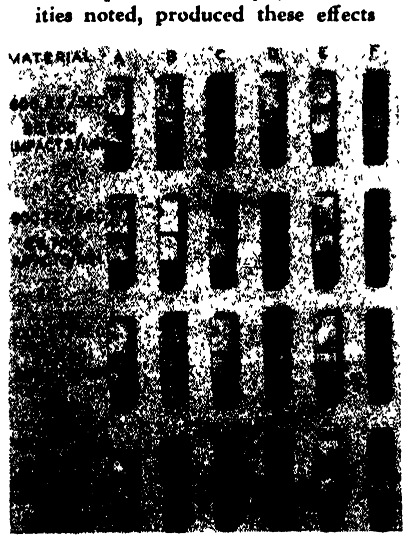
The question of metal erosion is fast becoming a problem of prime importance in many of the present day applications which are subjected to its destructive influence. The pitting of ship propellers and hydraulic turbine runners has long been a problem. Numerous investigations have been made in this country and in Europe in an effort to determine the cause of such pitting of metals. In one report covering data on 225 water turbines, 90 showed erosion to a more or less marked degree. Steam turbine blades and airplane propellers are also subjected to erosion.

Finger points to water jet in machine for determining erosion of steel by water

This wearing action was first thought to be of a chemical nature, the only part attributed to erosion being that of carrying away the products of corrosion. No doubt the two actions, chemical and mechanical, aid each other, but in most cases one or the other will be the predominating factor. The present opinion is that the erosion is caused by the impingement of water drops on the fast moving parts in the case of airplane propellers and steam turbine blades and to high pressures built up due to collapsing cavities in the case of hydraulic turbines and ship propellers The theoretical pressure built up on the surface of the metal upon impact with a drop of water has been calculated by several investigators to be from 50,000 to 70,000 pounds per square inch for a velocity of 1000 feet per second. Pressures in the order of 140,000 pounds per square inch may result from collapsing cavities of water-hammer effect.



Above: Sample ready for test (left) and eroded pieces. *Below:* 200,000 impacts of water jet, at velocities noted, produced these effects



To withstand these high pressures it is necessary that new and harder material be found. Before applying new alloys, however, some knowledge of their erosion-resisting properties should be collected. It would hardly be desirable, however, to wait until such information has been obtained from ordinary service operation. A means must be provided for rapid determination, by accelerated erosion tests, of the probable behavior of the various alloys when subjected to conditions similar to, but very much more severe than, those met in service. Hence the water jet tests from which many data have been obtained.

New Anesthetic

EXPERIENCE with a new anesthetic which is injected directly into the blood and which may prove as valuable as ether for certain types of surgical operations was reported by Dr. Gavin Miller of Montreal to the Canadian Medical Association.

The new anesthetic is called evipan and was produced by a German pharmaceutical manufacturer. It has been tried extensively in Germany and England. Only one death was attributed to the anesthetic in over 20,000 cases in which it was used. Chemically, evipan is known as the sodium salt of N-Methyl-C.-C.-cyclohexenyl-methyl-barbituric acid.

The anesthetic, injected directly into the blood stream through a vein in the arm,

produces a deep, normal sleep within 30 seconds. The operation can be started immediately. After the operation the patient awakens easily and gradually without any unpleasant after-effects. In Dr. Miller's experience, evipan is more effective if morphine or a similar drug is given first.

"If further investigation confirms my present experience," he concludes, "this drug may become as valuable to the surgeon as ether or novocaine for suitably chosen operations."—*Science Service.*

British Roadway Tunnel

A SUBMARINE highway tunnel, 2.13 miles long and 44 feet in internal diameter under the Mersey River, in England, has been built to improve communication between Liverpool and Birkenhead, and also to connect extensive highway systems which at present are separated by the river. The two towns, of 1,000,000 and 150,000 population, respectively, are on opposite sides of the river, but hitherto have been connected only by ferry steamers and the tunnel of the Mersey Railway, a local electric line. The main part of the new vehicle tunnel is complete, but some of the auxiliary works remain to be completed, and it is expected that the new route will be opened to traffic early in the summer of 1934.

The main portion of the tunnel, 5274 feet, or about a mile in length, is of circular section, 46 feet 3 inches in outside diameter and 44 feet clear diameter inside the lining. It is in a fissured and water-bearing sandstone formation and has a lining of cast-iron segments filled with concrete on the inside. A reinforced-concrete deck or floor, 18 inches below the horizontal diameter, provides a 36-foot four-lane roadway and two 4-feet sidewalks for the use of the patrolmen and tunnel staff. Two partition walls supporting this deck form a large central compartment for pipe lines or for some special form of transportation that may be developed in the future, while the two side areas are for the fresh-air supply to the tunnel.

In the main parts of the approaches on each side of the river, the tunnel is practically semicircular in section, with an invert about 7½ feet deep below the roadway slab. In these main approach tunnels the roadway width is 36 feet. On each side of the river there is a dock-side branch approach, consisting of a horseshoe tunnel 26½ feet in inside diameter, with a 19-foot roadway for two lanes of traffic. In both the main and dock-side approach or subterranean tunnels the entire invert space below the deck slab forms the conduit for the fresh-air supply.

The four open-cut approaches aggregate about one quarter of a mile, making the total length of roadway about 2.87 miles including the auxiliary or dock-side branches. On the direct route the length between main entrances is 2.13 miles, while between the dock-side entrances the distance is 2.08 miles.—E. E. R. Tratman, in *Engineering News-Record.*

Nickel's Fight for Life

NICKEL, so named because it was the "bad boy" of the metallurgical world, has become one of the most substantial citizens in the industrial empire. This development, during the past 50 years, provides a striking example of the value of scientific research.

Fifty years ago, says S. J. Cooke, in *Industrial and Engineering Chemistry,* nickel was worth a dollar a pound, and at that time the famous Krupp firm is said to have rejected, with more or less amusement, a suggestion that nickel might be used in the manufacture of armaments, on the ground that there was not sufficient nickel in the world to warrant experimentation in this field. Today, as the result of research, the Sudbury area in Canada supplies more than 90 percent of the world's consumption, which amounted to 57,000,000 pounds in 1932. An investment of more than 50,000,000 dollars is represented by this gigantic enterprise and thousands of employees earn their livelihood in this thriving industry.

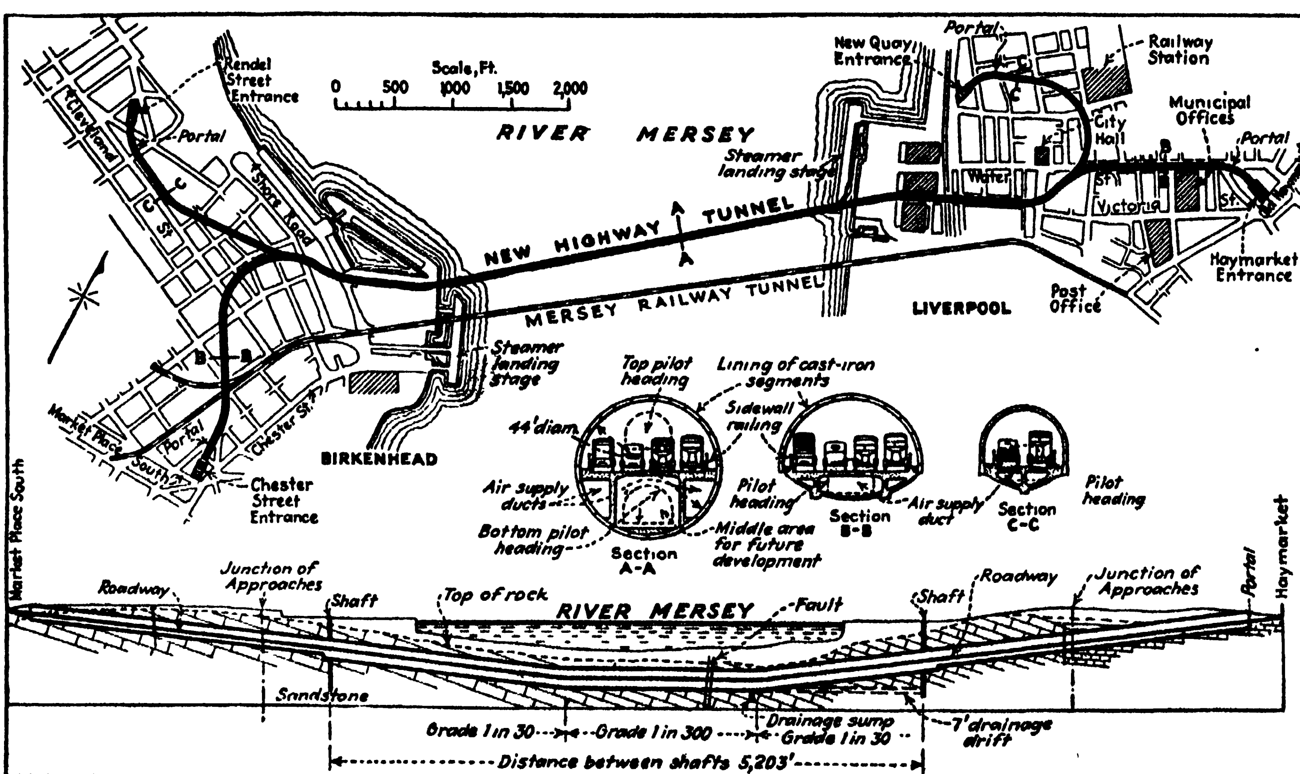
While production of nickel rose slowly in the years before the World War, the demand for armament purposes doubled the output in 1918. Then the consumption of nickel dropped to negligible quantities.

Volumes might be written about nickel's post-war progress. In many ways it is more spectacular than the chronicles of the early days. A huge enterprise, suddenly crippled, turned with courageous resourcefulness to make a place for itself in the ways of peace. For several years the situation seemed hopeless. Then slow and persistent research began to show results. How well the task of creating a peace-time work for nickel has been accomplished is evidenced by the fact that today it is used for hundreds of purposes and the world's annual consumption is 20,000 tons greater than it was at the peak of the war-time nickel demand.—*A. E. B.*

"Safe" Dry Cleaners Sometimes Dangerous

EXPLOSIONS of "safe" dry cleaning fluids have added another hazard to home dry cleaning efforts. Some of the so-called safe solvents sold for home use have been found to be decidedly unsafe. Fluids demonstrated to have been perfectly safe when first used have exploded after being used a few times.

This contradictory behavior has been simply explained by the results of laboratory experiments. These dry cleaning flu-



Courtesy Engineering News-Record

Diagrams of the Mersey River Tunnel which is described in detail in the columns above

ids are made up of regular dry cleaners' naphtha to which has been added enough of an inert solvent, carbon tetrachloride, to make them non-flammable. One half carbon tetrachloride and one half naphtha makes a suitable mixture.

While in use the carbon tetrachloride evaporates more rapidly than the naphtha, thus leaving a mixture rich in naphtha and hence explosive. Experiments show, for example, that when 37 percent of a total mixture originally composed of 43 percent carbon tetrachloride and 57 percent naphtha had evaporated there remained a mixture made up of 29 percent carbon tetrachloride and 71 percent naphtha a decidedly unsafe product.

Fluids made up entirely of carbon tetrachloride or other non-flammable solvents remain safe indefinitely.—*Science Service.*

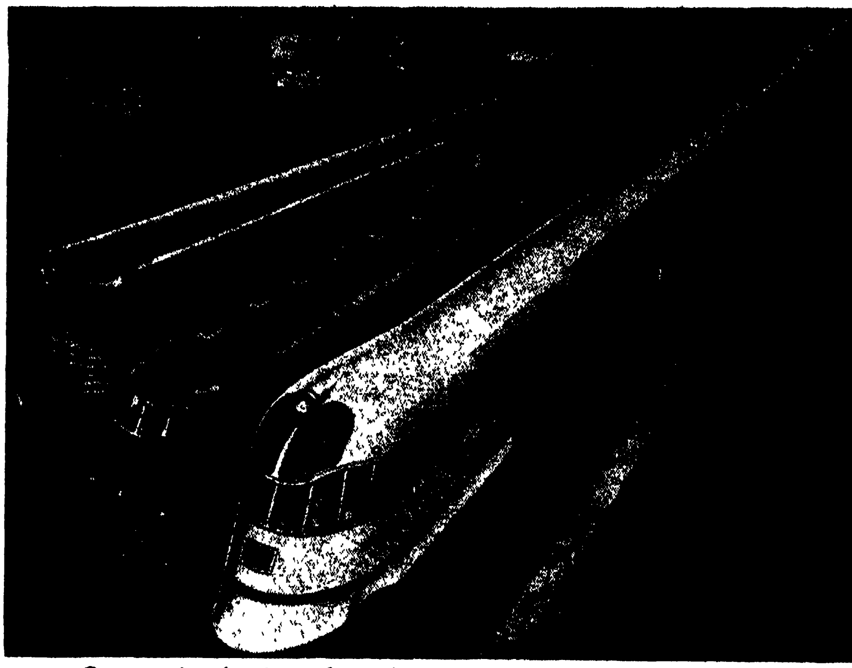
Motor Trains in Contrast

SO swiftly is motorization coming to the railways that already an evolution in equipment is taking place.

The upper left train in the photograph is the Texas and Pacific two car train, now running daily between Fort Worth and Texarkana, Texas, a distance of 249 miles It is equipped with two 12-cylinder gasoline engines. An air conditioner changes the interior atmosphere every few minutes Moderate streamlining reduces wind noises as well as wind resistance. Seventy-eight miles per hour is the maximum speed of this *Texas Ranger*

In the center of the picture is Britain's first streamlined railroad car, shortly to be introduced by the Great Western Railway between Reading and Slough. As yet British operators have not taken to the "articulated" train, preferring to experiment with individual self-contained units. The Britisher is of unique design, resembling a huge seaplane float. It has a seating capacity of 69, is capable of 60 miles an hour and is driven by a single 130 horsepower oil-burning engine.

In the foreground at the right is a photo-sketch of the Burlington *Zephyr*, product of the E. G. Budd Manufacturing Company in Philadelphia. It is hailed as the "last word" in motorization due to its full aerodynamic lines and its 600 horsepower Diesel engine, capable of a maximum speed of 2 miles a minute.



Comparative drawings of two American and one British motor trains

Glass Pipes in Industry: The laboratory glass-ware of the chemist is probably responsible for the application of glass in commercial processes. The above installation of glass piping has advantages of resisting the action of chemicals that would ruin any ordinary pipe

Courtesy General Plastics Inc.

Durez, a new synthetic plastic, has made possible a "pee-wee" camera that takes real pictures, yet costs only 50 cents. Shown in foreground, the camera takes vest-pocket film and makes negatives that, as indicated in the background and upper corner, are capable of being satisfactorily enlarged

Oxygen's Rôle in Corrosion

THIRTY years ago, R. W. Whitney, now vice-president of the General Electric Company, announced that the corrosion of metals was an electrochemical process and this view is now generally accepted, says *Water Works and Sewerage.* When a metal is in contact with even slightly acidic solutions, corrosion takes place by the chemical process of the metal replacing the hydrogen in the acid. The acid dissolves the metal and thereby hydrogen is released.

Released hydrogen coats the metal surface with an electrically charged layer that prevents the chemical reaction from continuing at the initial rate. If the hydrogen layer is built up to a sufficient thickness the reaction is practically stopped. However, under natural conditions, the hydrogen combines with the oxygen of the air or that dissolved in the water to form more water and solution of the metal goes on. The amount of oxygen available to remove the protective hydrogen blanket determines the extent of corrosion.

Impure metals are corroded more quickly as a rule than pure metals. Electrochemists believe that this is due to the impurities taking up the oxygen. Contrary to the popular belief, however, pure metals are subject to corrosion under the action of certain acid solutions. Prof. O. P. Watts of the University of Wisconsin has recently shown that if oxygen is absolutely excluded, copper will not corrode in a solution of sulfuric acid, a reaction that is very rapid in the open.

The importance of the dissolved oxygen content of the atmosphere, of corrosive water and other liquids, is thereby once more emphasized as an important factor in the corrosion of iron and steel that costs America a staggering sum each day.—*A. E. B.*

Meteorite—Or What?

READERS of scientific journals frequently report meteorites, or supposed meteorites, found in their vicinities and such reports are usually turned over by the editors to some astronomical authority specializing in meteors. In answer to one such report, Professor C. C. Wylie, of the Department of Astronomy at the Iowa State University, Iowa City, Iowa, and head of the Midwest Meteor Society, names three kinds of finds which have so odd an appearance that they are often reported as meteorites:

"Light and porous material, a little different from the ordinary power plant cinder, may be made in three different ways—or at least we get specimens which are apparently made in the three different ways.

"One of these is the foundry cinder, made by melting the sand surrounding the casting which is being made.

"Another is the straw-stack cinder. When a dry stack of straw on the farm is set on fire it sometimes burns with great heat. In the interior, where there is little air, the heat may be sufficient to melt the silicates in the straw. As the melting silica bubbles, a very porous cinder is formed.

"The third is the fulgurite, which is formed when lightning strikes in a sandy soil. A similar fulgurite may be formed when a power line goes down and the high voltage current arcs into sandy soil.

"I have seen no definitely authentic specimens of meteorites which are really porous."

Heredity to be Controlled by X Rays?

FOR generations it has been the dream of the experimental biologist to change the hereditary characteristics of animals and plants—to make and control variations, and to originate new species at will. In his attempt to do so he has subjected living matter to every sort of stress which he could think of—to the action of heat and cold, starvation and repletion, chemicals and electric currents directly applied. And always, no matter how great might be his injury to an animal or plant, it continued to reproduce normally. The agriculturist was dependent upon the method of hybridization, cleverly using chance variations, to perpetuate those improvements which he might detect in plants.

Very shortly after the invention of the cold-cathode X-ray tube in 1899, it was realized that there was something very odd about the way in which these new electromagnetic radiations affected living tissue. But the cold-cathode X-ray tube, because of its uncontrollably variable characteristics, was a poor tool, and for long the genetic action of X rays remained shrouded in complete mystery.

In 1926, Dr. E. L. Johnson employed a hot-cathode tube capable of yielding known doses of radiation of known characteristics. By a careful study of the effects of various exposures of X rays on the seedlings of tomatoes, sunflowers, and cosmos, she found that her seedlings not only developed the most unusual characteristics such as ribbon-shaped stems, increased branching, dwarfing, doubled leaves and flowers, but developed a shorter period from planting to flowering. Also an initial decrease, followed by a marked increase in the growth rate.

Many of the unusual characteristics were actually transmitted faithfully to following generations, and it was made clear that here was a field in the application of electricity to plant growth which was worthy of the most vigorous investigation. Vigorous investigation has followed. Dwarf, giant, and odd-leaved tobaccos, odd tomatoes, mosaic maize and other grains, cotton strains in which the seed is free of the lint and which produce giant seeds, and rapidly maturing potatoes are but a few of the results of the toil of hundreds of work-

ers, who, all over the world today, are studying genetic effects of X rays.

They have found that X rays have the power to perform a miracle which can be brought about by no other known agent, save cathode rays, under man's control today—the power virtually to cause evolution, to produce new forms of plant life whose descendants will be like themselves. Changes are due to the action of the rays on the chromosomes—those minute bands of protoplasm-fiber which lie at the center of every living cell and are responsible for every characteristic of the plant or animal bearing them. Chromosomes can be broken, reunited, and deformed in dozens of ways by X rays, and, depending upon the minute nature of those deformities in the germinal cell of the plant, that plant and all its descendants may present variations.

The possibilities, as applied to man's welfare, of being able to modify in controlled fashion the heredity of domestic plants are nearly endless. Even by the entirely empirical methods which have been used in the past, remarkable results have been achieved, and what may the future hold? A cold-resistant orange type might result that would extend the citrus-fruit orchards much farther to the north. New vegetables and new flowers will always find a ready market if they are superior to old ones, and the general life-level of humanity will be raised at the same time.—*From a talk by C. P. Haskins of the Research Laboratory, General Electric Company.*

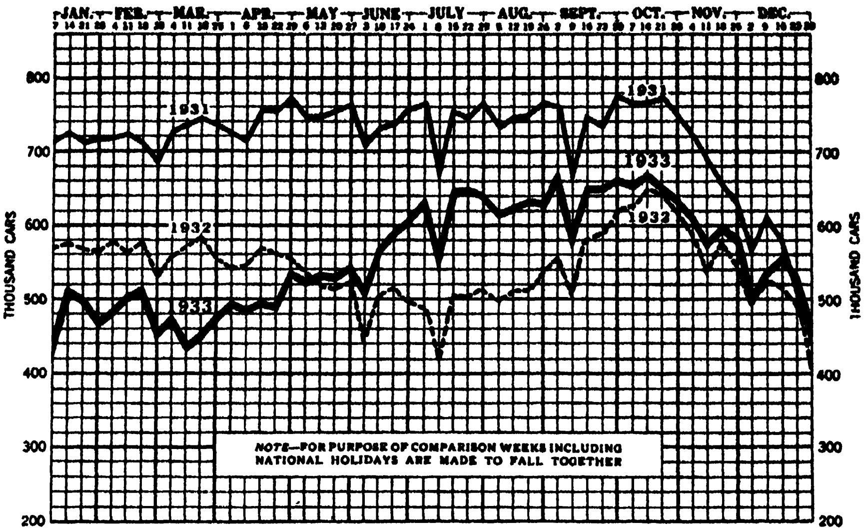
Apparatus to Move Full Grown Trees

IN the old days trees used to stay put—at least until they felt the sting of an axe. With the aid of modern tree moving machinery such as that shown in the accompanying photographs, however, tree men now move and transplant 60- and 70-foot trees like so many pots of crocuses. In other words, if you want a 90-year old tree in your front yard, you don't need to wait for a sapling to grow up. You can have a veteran elm moved in tomorrow.

The mover shown in one of the photos is used to maneuver specimens weighing up to 30 tons or more. It's all steel—and it's all-electric welded in the shops of the Davey Tree Expert Company, Kent, Ohio. The smaller mover carries loads up to around 10 tons.

Due to the nature of the service, these movers are frequently over-loaded, stuck in heavy mud, twisted, pulled, pushed but seldom broken. Having been welded with equipment manufactured by The Lincoln Electric Company, it is reported that no weld failures have ever occurred.

Above: **A tree mover with a capacity up to 10 tons.** ***Right:*** **A beautiful specimen of a huge tree loaded on an arc-welded mover with a dead-weight capacity of 30 tons**



One of the most important barometers of economic conditions: Revenue freight-car loadings for 1933 (heavy black line). It will be noted that in May, loadings per week exceeded those of the same weeks of the year 1932; and that in December, 1933, the loadings even jumped ahead of those two years ago

"Children of Depression"

ONE of the most interesting exhibits at the 1934 Chemical Show was that of *Industrial and Engineering Chemistry* entitled "Children of Depression." In this display was shown samples of the many new products that have been developed in American chemical laboratories as a result of efforts to reduce production costs and to introduce new and improved products by means of which the chemical industry has attempted to work its way out of the depression. Among the new products were the following:

Windows for Tin Cans. Inserts of Pyrex glass are now placed in can tops to allow visual inspection of contents. The tops containing the inserts are rolled and soldered into the cans on standard automatic production machines without change of adjustment. All or any proportion of the cans finished on the machine can be provided with glass insert tops.

Gasoline Antioxidants. DuPont mono-benzyl-p-aminophenol is a powerful antioxidant for use in cracked gasolines to stabilize them against gum formation. It is effective in a concentration of one pound (0.45 kg.) in 100,000 gallons. DuPont Gasoline Antioxidant No. 2 is used to stabilize cracked gasoline against discoloration in concentrations of 1 pound in 35,000 gallons.

Nembutal. Sodium ethyl (1-methylbutyl) barbiturate. It possesses an unusually high pre-anesthetic and hypnotic efficiency, and is also sedative and anti-spasmodic in small doses. As a pre-anesthetic sedative it induces sleep without struggle, allays apprehension and fear, allows the quiet induction of anesthesia, reduces the amount of volatile anesthetic required, tends to prevent undue subsequent reactions with local anesthetics, and diminishes post-operative complications.

Inconel. An alloy of 80 percent nickel, 14 percent chromium, and 6 percent iron. It is stainless, resists heat and acids, and has high design strength. It is used for dairy and creamery equipment and for numerous purposes in the process industries as well as for heating elements.

S-D-O. A polymer of divinylacetylene dissolved in solvent naphtha. It serves as a synthetic drying oil and is used as a coating for the protection of metals, concrete and wood against corrosive action of acids, alkalies, solvents, and other deteriorating influences.

Dreft. A synthetic detergent made from the fatty alcohols produced by the catalytic reduction of the ordinary fatty acids with hydrogen. Its active constituent is sodium alkyl sulfate. Its outstanding characteristic is its solubility in hard water. It lathers and cleanses as well in sea water as in distilled water and is not precipitated by acid, alkali, or metallic salts.

Kork-O-Tan. A material originally developed for use in gaskets. It is strong and compressible and is ideally suited for use with many organic solvents. It is made from granular cork with rope and jute fibers saturated with a flexible binder. It is extremely flexible, is easily cut to true edges, does not harden with age, and can be folded

or bent without cracking or permanent distortion. It is also used under rugs to prevent slipping and in press blankets for modern high-speed printing presses.

Vinethene. Divinyl oxide (CH_2:CHO-CH:CH_2) is a general anesthetic having an anesthetic potency seven times that of ether and chloroform. Complete surgical relaxation is obtained in two to four minutes, and recovery is complete in 30 to 60 seconds. Post-operative vomiting and other undesirable by-effects are less frequent than with ether.—*A. E. B.*

Starchless Potato Produces Diabetic Sugar

CREATION of a starchless potato has been accomplished through the efforts of Dr. Harold Hibbert, Professor of Industrial and Cellulose Chemistry at McGill University, and Dr. R. F. Suit, Professor of Plant Pathology at MacDonald College.

Starch in the potato has been displaced by a complex sugar known as inulin. This sugar, Dr. Hibbert pointed out, "offers no trouble to the diabetic, in contrast to that of starch, which is derived from glucose."

The experiments by which the starchless potato was produced are described by Dr. Hibbert as follows:

"Following the conversion of sugars into synthetic cellulose by bacteria, and of the cellulose in turn into artificial silk, thus completing the synthetic conversion of sugar into rayon, the idea presented itself that perhaps it might be possible to alter a given plant species by introducing into the growing plant either the living organisms, bacteria, or the enzymes which these bacteria create during their life cycle.

"For this purpose it was necessary to select a type of plant, such as the potato, in which the enzymes (in the course of plant growth) under the influence of light convert the carbon dioxide and water present in the air first into sugars and then into starch, and to use for comparison a similar type of plant; for instance, the artichoke, the enzymes of which convert the sugar present into a substance known as inulin, a fructose type of sugar and not a glucose as in starch.

"Experiments were initiated in co-operation with Professor Suit in which a foreign bacterial culture—namely, one more nearly associated with the inulin type of sugar-forming bacteria—was introduced into the young, growing potato plant.

"The culture found its way into the roots from a supply located on a stout stem. In a few days the new bacteria gave rise to the formation of a starch-free potato."

Dr. Hibbert said if the reproductibility of the new types could be established it might "provide the possibility of obtaining a variety of other new types capable of serving as special foodstuffs."

Microscopic Sherlocking

THE following *Science Service* note should be of especial interest to those who have been following our series of microscope articles, one of which appears on page 130.

Dr. Johannes Grüss, research professor at the Institute for Fermentation Industries at Friederichshagen near Berlin, might well be termed the scientific pot-snooper of the centuries. A great part of his research con-

sists in the minute examination, with microscope and test-tube, of dregs and lees and pot-scrapings found dried and hardened at the bottoms of vessels dug up in ancient towns and tombs. He knows what yeasts fermented beer in ancient Egypt--and how careless Pharaoh's servants were about filtering the water they put into the jars. He knows what the women of the Bronze Age in Germany cooked for their men—and how they sometimes let the milk scorch, presumably while gossiping with the neighbors. In Dr. Gruss' patient and painstaking hands, the meanest dregs become significant.

His latest investigation, as related in *Die Umschau*, has been the microscopic and chemical examination of several earthen pots found in a village site of northern Germany that dates back to the earlier Middle Ages—somewhere between the 7th and 10th Centuries. As found in the ruins, these pots were filled with lumps of earthy material, containing a certain amount of fatty substance.

Microscopic examination isolated cells characteristic of the flax plant. Presumably therefore these pots once contained linseed oil. This presumption is strengthened by the presence of tiny scraps of linen fabric, dyed in two colors, reddish and slate-blue. However, the fat in one of the vessels may have come from hazelnuts, for the microscope also showed up fragments of hazelnut shell.

Before the pots were used for holding linseed oil they had been used for cooking—and none too well cleaned afterward, for Dr. Gruss found remains of various kinds of vegetables in them, as well as bits of finely crushed bone. There were starch grains from two species of wheat, slivers of ruta-baga or beet, fragments of radish. One of the pots had an identifiable scrap of carrot and cells of either beans or peas: possibly that old standby of modern tables, carrots and peas, dates back at least a thousand years.

Certainly two of man's unwelcome insect house-guests were there, for in one of the pots Dr. Grüss found microscopic scales from the wing of a clothes-moth, as well as the remains of a bedbug. The latter insect, he explains, is not exclusively a blood-sucker, but will take to any kind of liquid food on occasion. Apparently the six feet of this unlucky specimen slipped and it found itself in the soup, to remain there for more than a millennium, until a German archeologist-with-microscope should find it and tell its little tragedy.—*Science Service.*

Built into this new cord for use on many electrical appliances is a spring-like arrangement that prevents kinking of the cord at all times and thus lengthens its life

Gin Comes Out of the Bath Tub

PROHIBITION, no matter what else it accomplished or failed to accomplish, did at least one thing. It lifted gin out from the shady and somewhat disreputable regard in which it was held before the dry era and made it fashionable. Tipplers who once disdained it, save in an occasional cocktail, not only learned to drink it, but actually to make it—or rather to make something that was sold and drunk as gin.

Leading manufacturers of distilled spirits are inclined to give gin a prominent place on their production schedule. Plants, closed or operating on a restricted basis during the long years of aridity, are being modernized and reopened with increased capacity. New ones are springing up both in this country and Canada. Thirsty Americans, having become accustomed to the bath-tub variety, are now to have full opportunity of tasting the real product.

However, true gin can not be made by bath-tub methods. The genuine liquor contains about 50 percent alcohol by volume and is smooth with a delicate flavor possible only with the proper equipment and careful methods. That raw harshness so commonly associated with gin is entirely a product of the bootleg era.

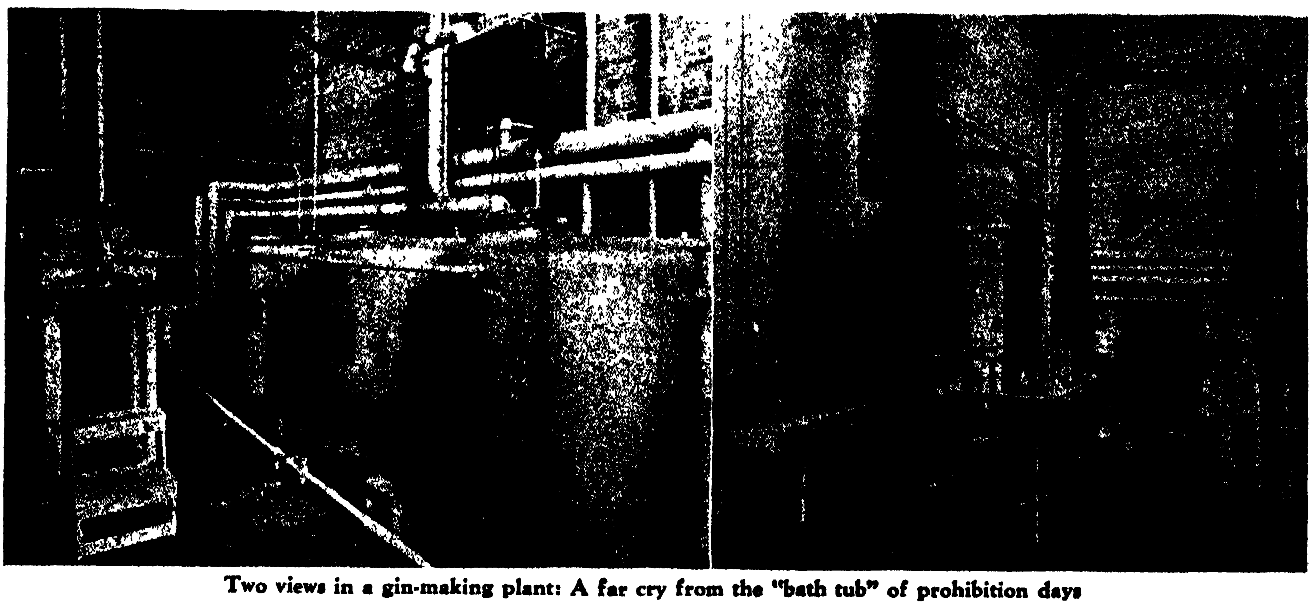
Contrary to a widely accepted belief, gin never was made by the distillation of fermented juniper berries. It is produced from alcohol obtained by the distillation of a cereal mash. The exact ingredients of this mash differ in the English product or London gin, and Holland gin or schnapps.

In the past, gin distillers have experienced considerable difficulty through metallic contamination of the distillate, which is corrosive to many metals and detrimental to its delicate flavor and brilliancy. The accompanying illustrations were taken in the new plant of W. and A. Gilbey Limited at New Toronto, Ontario. Here pure nickel and Inconel--the new nickel-chromium alloy containing approximately 80 percent pure nickel—are used extensively for equipment coming into contact with the distillate in various forms to prevent this contamination. Both of these metals are resistant to corrosion and are without effect on the flavor and brilliancy of the product.

The Universe in Miniature

A MINIATURE planetarium, literally a working model of the Universe—that is an apt description of the "astrophane," just installed on the Rockefeller Center Observation Roof, atop the RCA Building, 70 stories above the sidewalks of New York.

The astrophane, designed by Otto J. Russert of Hoboken, New Jersey, an engineer, artist, and amateur astronomer, consists of a large transparent globe supported by a wooden base. This globe represents the celestial sphere, and on its surface are



Two views in a gin-making plant: A far cry from the "bath tub" of prohibition days

shown in colors the various constellations of the sky and the visible stars.

Inside the globe, supported on thin metal sticks, are represented the visible planets in their general location about the Sun. These include Mercury, Venus, Earth, Mars, Jupiter, and Saturn.

By means of an operating mechanism within the base of the astrophane, the relative positions of the planets to each other and to the Sun, and to the constellations and stars, may be indicated at any selected year, month, and day. The various constellations and stars may readily be identified by reference to the globe and to the sky.

The astrophane described here

The transparent globe of the astrophane, representing the celestial sphere, is marked with the outlines and names of the various constellations. Several thousand stars are shown in their relative positions in the constellations by star-shaped figures and dots. The significant stars are connected by dotted lines, so that the figures as pictured by the ancients may readily be found. Commonly known stars of the different constellations are designated by their names or Greek letters. The order of magnitude is shown by their relative sizes and colors.

The celestial equator is indicated on the globe by a circumferential white line in a horizontal plane midway between the portions representing the north and south poles of the universe. Right ascension lines from pole to pole and declination lines parallel to the equator enable the position of any body in the sky to be located, in a manner similar to the location of a point on the earth by reference to its longitude and latitude.

Unique Automatic Pencil

Of all the thin-lead mechanical pencils which we have seen in recent years perhaps the most complete in every respect was recently called to our attention by the Stylofede Corporation. This pencil has a combination of automatic features which does not seem to have been approached by any other.

In the first place, the feed of an entire supply of 12 leads placed in the barrel is continuous and automatic until all the leads have been used. When the point wears down or is broken off, it is only necessary

(*Please turn to page* 161)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

PITTSFIELD, Massachusetts, amateur astronomers and telescope makers (Berkshire Astronomical Society) have long been rarin' to go and now they are going places, according to a screed sent in by A. H. Scott, 20 Bishop Parkway, that city. Read:

"Pittsfield, Massachusetts, the home of A. R. Everest, the discoverer of *H. C. F.*, is now permanently on the astronomical map—its first observatory has been formally

Roofing the observatory

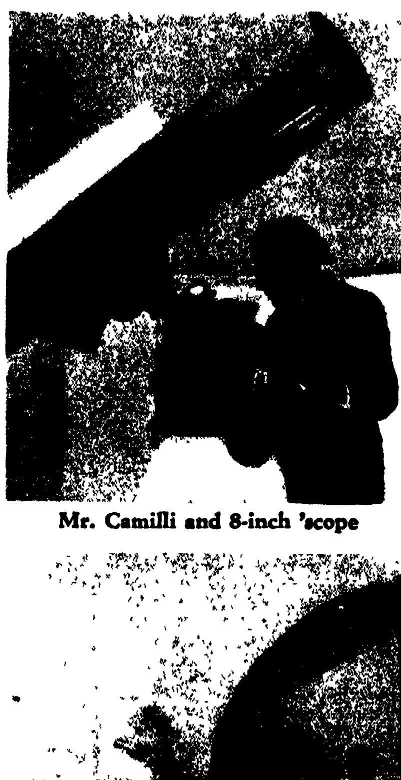
dedicated. The builder was Guglielmo Camilli, a General Electric Company engineer who entertained 30 of his fellow star gazers at a dedication dinner prepared in true Italian style. In honor of the great Florentine physicist Galileo Galilei, who was the first to apply the principle of the telescope to astronomy, in 1609, the observatory was christened The Galileo Observatory.

"Patterned after its conventional big brothers, with revolving dome and electrically operated 'scope, the observatory is scientifically constructed throughout. The building is 12 feet in diameter, with reinforced concrete walls six feet high. The concrete pier on which the telescope is mounted extends four feet into the ground and insures absolute rigidity. A series of rollers and guides is embedded in the top of the concrete wall and supports a channel iron bent in the form of a perfect circle. Supported by semi-circular cross members, the galvanized iron dome is built of 45 segments, all accurately cut to size and punched for rivets in advance. Nearly 3000 rivets and 50 pounds of solder hold the dome together and make it water-tight.

"The 'scope is an eight-inch reflector with a mirror by Everest, and is electrically operated by means of a Telechron clock mechanism. The axes can also be adjusted by hand wheels. All the machine work and scale graduations are of the greatest accuracy.

"The only cost was for materials, as enthusiastic fellow astronomers helped Mr. Camilli from start to finish of the project. All trades, from wood choppers who cut 300 trees, to electrical engineers and professional mathematicians were represented. To place the observatory in operation it was necessary to extend a transmission line through a swamp a quarter of a mile to the isolated knoll on which it is built. Electricity therefore lights and heats the building (when work is to be done in cold weather and no observations are scheduled). Resistance wire around the sliding door in the dome, but insulated from it, can be used to thaw it loose in cold weather in case of ice or snow accumulations. The grounds outside have not been neglected, rose bushes and other shrubs being planted on the carefully leveled terraces around the building."

It sounds like business—doesn't it!



Mr. Camilli and 8-inch 'scope

ONE lady who evidently thinks telescope making is more fun than embroidering is Miss Wandalee Nickell, 716 North Isabel Street, Glendale, California. Here is what she wrote to us recently. Read it, show it to your mother, wife, daughter, girl friend, or what have you, and proceed to introduce her to the sacred rites of glass grinding.

"I had my first view through a telescope two years ago, at the moon," says Miss Nickell. "The moon has been the cause of many events in life, but it gave to me that evening a most compelling urge to possess a telescope of my own, in order to study its beauty whenever I desired. I was 17 at that time and felt rather helpless, knowing I could not buy one. But something inside would not let me put the desire aside.

"I was studying astronomy in high school and my instructor told me of your column, 'The Amateur Astronomer,' in the SCIENTIFIC AMERICAN. Until then I was unacquainted with the magazine but I have never missed a copy since. In the first copy that I turned to I found information which spurred me on—it was a picture of Mr. A. B. Stephens grinding a mirror in Burma, China. He was returning to this country, so I immediately got in touch with him. He is the nephew of the beloved optician, the late Dr. John A. Brashear. Was it a kind hand which guided me to him? I think so, as he proved to be my sole inspirer and I surely needed plenty of encouragement at the time, as my age, sex, and lack of optical knowledge were all against me. He had me obtain 'Amateur Telescope Making,' which was, I assure you, all Greek at first. But with plenty of hard studying on my part and patience on the part of a kind physics teacher under whom I was studying, I soon was able to get under way with my six-inch

Dedication of the Galileo Observatory at Pittsfield. Camilli is holding the union end of the flag, while Everest stands with both hands on the lapels of his coat

mirror. I shall never forget the inner thrills I experienced when knowledge was dawning upon me while I ground away hour after hour with success always in front of me—I never once thought of having a failure.

"As my mirror progressed I was worrying about the mounting. I had conquered optics to a certain extent, but mechanics were and still are a mystery to me. I owe

The lady and the telescope

a great deal to my father and other friends who helped me so wonderfully in getting it constructed.

"As I went along I learned by making mistakes. My first one was not fine grinding long enough with my last grade of Carborundum, so I had to polish for 30 hours to get the polish complete. I had the usual turned-down edge, but did not encounter any real difficulty in parabolizing. My mirror has a very excellent figure. The focal length is 37¼ inches. I can use up to 300 power with good definition. In the picture you will notice that I have a finder on the telescope. I am proud to say I also ground and polished the lenses for this, and have made two eyepieces to date. I worked on the instrument over a period of ten months, and the cost was approximately 75 dollars.

"I have used my telescope now for a considerable time and cannot begin to relate all the happy hours it has given, not only to me but to hundreds of others. I want to say here that 'Amateur Telescope Making' was the life saver and giver of many hours of beauty to be spent with the heavenly bodies. I hope this story will spur other girls on into the beautiful field of telescope making. There is no reason why it should be limited to men. If one girl can make one, hundreds of others can."

So far as we know, Miss Nickell is the fourth woman who has qualified as a telescope maker and we wish there were more. Women often get the notion, based on a preconception, that they cannot do any kind of mechanical work simply because they are women. Yet take needlework—is it not mechanical work? Some of it, embroidery for example, is too refined for the average mere man. Men make good tailors, and even your scribe can sew on a button—with a six-inch upholstery needle. So there is no "man's" or "woman's" work. Ladies, try a telescope.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

SOME RESULTS FROM FEEDING SPRAY CHEMICALS TO ALBINO RATS (Research Bulletin 183, College of Agriculture, Agricultural Experiment Station), by T. J. Talbert and W. L. Taylor. It is now common knowledge that the United States Food and Drug Administration of the Department of Agriculture does not permit foreign or interstate shipments of apples which contain an arsenical residue of more than a certain tolerance. The so-called tolerance or amount of arsenic trioxide permitted on the fruit was apparently arrived at without adequate scientific information or evidence. The writers have therefore undertaken to secure experimental evidence to show the toxicity of spraying chemicals. *University of Missouri, Columbia, Missouri.—Gratis.*

INDUSTRIAL RESEARCH LABORATORIES OF THE UNITED STATES (Bulletin of the National Research Council No. 91). A 203-page alphabetized listing of 1575 industrial and consulting laboratories, with addresses, names of staff members, and work done in each. *National Research Council, 2101 Constitution Ave., Washington, D. C.—$2.00.*

A REPLY TO INLAND WATERWAYS, being comments of the Mississippi Valley Association upon a memorandum submitted to the Hon. John Dickinson, Ass't. Sec'y. of Commerce, by the Association of Railroad Executives. The pamphlet can be obtained from the *Mississippi Valley Association, 511 Locust Street, St. Louis, Missouri.—Gratis.*

NOTES ON A PHOTO-ELECTRIC GLOW-DISCHARGE OSCILLATOR, by B. Melchor Centeno V., E. E. This new device is an improvement over the usual type of glow-discharge oscillators, permitting a greater elasticity in the control of the generated oscillating currents and making possible many new and practical applications in the field of electronics. *Melchor Centeno V., 202 West 81st Street, New York City.—20 cents.*

THE EVOLUTION OF INTERNATIONAL AMERICAN CONFERENCE SERIES (Congress and Conference Series No. 11), by William Manger, Ph. D., Chief Division of Financial Information, Pan American Union. International co-operation has always been a characteristic of the American continent. In fact, the very existence of many of the republics as independent nations is due in large measure to the assistance mutually rendered during their struggle for independence. With the achievement of independence this policy of mutual helpfulness and co-operation found expression in the practice of convening international conferences, dating from 1826. This brief pamphlet describes the earlier conferences. *The Pan American Union, Washington, D. C.—Gratis.*

DAIRY FARMING AND FRUIT GROWING are bulletins and circulars issued by the New York State Agricultural Station. A list of the publications can be obtained from *Prof. J. D. Lucksett, Station Editor, New York State Agricultural Experiment Station, Geneva, N. Y.—Gratis.*

MODERN TUBE INDEX No. 2 is a large table giving the type and use, the base type (referring to diagram), the plate ratings, the screen ratings, the grid volts, characteristics, normal services, and remarks about radio tubes. Other information is given in subsidiary tables. *John F. Rider Publications Inc., 1440 Broadway, New York City. 25 cents.*

WAR DEBTS (International Conciliation, November, 1933, No. 294), which contains articles by Harold D. Gideonse and Irving Brant, deals with a very practical subject. Few know how the debts were contracted; this pamphlet tells about it. *Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass.—5 cents.*

SMOKELESS SHOTGUN POWDERS, by Wallace H. Coxe, Ballistic Engineer, Burnside Laboratory, deals with their development, composition, and ballistic characteristics as they affect the action of shotguns. It is packed with 103 pages of valuable information fully documented, and the bibliography is excellent. It is an extremely valuable contribution to the subject. *E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. -50 cents*

WHY UNITED STATES REFINERS COMPLAIN. The question of sugar is of perennial importance. The refineries of the United States are already overbuilt, so it seems unnecessary to import refined sugar from Cuba and our island possessions, which means a duplication of mainland facilities, and represents a departure in national policy, resulting in less wages, as well as less use of materials, containers, fuel, and power in the United States. *American Sugar Refining Company, 120 Wall Street, New York City.—Gratis.*

WINTER FEEDING OF WILD LIFE ON NORTHERN FARMS (Miscellaneous Publication No. 159, U. S. Department of Agriculture), by Wallace B. Grange. Wild life in northern climates needs man's help in winter. The sheaf of grain that in some European countries is raised on a pole at Christmas time symbolizes man's response to the need of wild life; but more than a symbol, more than an offering at a single season is required. This pamphlet gives rational directions for feeding. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

GUIDEBOOK OF THE WESTERN UNITED STATES (Geological Survey Bulletin 845), by N. H. Darton, deals with the Southern Pacific Lines—New Orleans to Los Angeles—which pass through a great variety of geographic and industrial conditions. There are numerous maps and illustrations and the volume of information is enormous. It makes a book of 301 pages and is a capital guidebook to the region covered. *Superintendent of Documents, Washington, D. C.—$1.00 (money order).*

REPORT OF NAT. SCREW THREAD COMM. (Bureau of Standards misc. publications No. 141). Machine tool manufacturers have been waiting for some years for this pamphlet, which is a complete study of screw threads. A vast amount of work was involved in compiling this pamphlet. It is illustrated by 56 engravings. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*

A READY REFERENCE FOR PLASTICS. This is a compilation of data by a company who mold phenolics, ureas, and cellulose acetates into various forms and shapes. This is a brief description of commonly used plastics and has been compiled for the guidance of engineers and buyers, and, as far as we know, gives a unique set of figures. *Boonton Molding Company, Boonton, New Jersey.—Gratis.*

ALDEN PRODUCTS CO. This catalogue gives a very complete radio socket layout chart, together with information on modernizing obsolete tube checkers and set analyzers, and is brimful of valuable information *Alden Products Company, 715 Center St., Brockton, Mass.—Gratis.*

HORIZONS, by Norman Bel Geddes. We are entering on a new era which is characterized by design in various specific phases. Thus we have streamlined locomotives, automobiles, cars, and ocean-liners. Mr. Geddes is a well known designer of theater scenery and properties. This pamphlet is an excerpt from a book published by the De Soto Motors Corporation, a division of the Chrysler Corporation. The complete book, issued by Little, Brown ,and Company, sells for $4.75. The pamphlet is issued by the *Institute of Aerodynamic Research, General Electric Building, New York City.—Gratis.*

AMERICAN PSYCHICAL INSTITUTE (Bulletin 1.) This is the opening publication of a newly organized society for psychical research. Its main content is a 75-page account of exhaustive experiments on the mental independence of a spirit control apart from the conscious or subconscious mind of the medium. *American Psychical Institute, 20 West 58th Street, New York City.—$2.00.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 157)

to press the point of the pencil firmly against a hard surface and lift up quickly in order to have a new lead project outward to the proper writing length. The pocket clasp lies perfectly flush with the surface of the barrel while the pencil is in use but for attaching to the pocket this clasp is raised by a simple twist of the barrel and is released to catch the pocket firmly by pressing its upper edge.

The Stylofede is neatly made of a hard composition with gold-finished metal parts and is well balanced to the hand.

Odd Uses of Sulfonated Oils

FOR many years sulfonated vegetable oils have been used in the textile trade as softening and finishing agents. Of late, however, these same sulfonated oils have been applied to a wide variety of other very interesting uses, some of which are described by A. J. Kelly in a recent issue of *Chemical Markets*. The distinguishing property of the sulfonated oils is their ability to solubilize or emulsify practically every type of water-insoluble solvent or lubricant.

The cosmetics industry is now consuming a considerable quantity of turkey red and other sulfonated oils. Many shampoos, as well as permanent-wave preparations, are based on sulfonated castor oil. Brushless shaving creams also contain this versatile product. And there is one compound which is to be added to the bath and is advertised to bring a breath of the pine woods to the bath room. Neutral turkey red oil and a little of some aromatic pine derivative such as terpineol does the trick. Sulfonated castor oil is used to solubilize perfumes for the manufacture of theater sprays, as well as other deodorants or anti-odorants. In fact, water soluble perfumes for every sort of use are prepared by blending the essential oils with the sulfonated oils.

Sulfonated oils are used in preparing asbestos products. They are quite largely consumed in the processing of leather, and for this application sulfonated cod oil is often desired. Sizing preparations for paper and for book-binding materials sometimes contain sulfonated castor oil. It is also used on wood in a few particular lines. Cutting oils for the metal workers can be and are made with sulfonated oil. And certain water soluble tints and stains are improved with soluble oils.

Sulfonated castor oil will clean paint brushes handily—and mixed with kerosene will remove grease and dirt from the hands, with no harmful action on the skin.—*A. E. B.*

Women Poorer Reasoners, Better Hint Takers Than Men

IF women do not reason as well as do men, they are better at taking hints, with the result that they may more nearly approach the achievements of men. This is one conclusion drawn from a series of reasoning tests given 384 students at the University of Michigan by Dr. Norman R. H. Maier of the University psychology depart-

ment, reported in the *British Journal of Psychology*.

Using students in the beginning psychology course as subjects, Dr. Maier divided them into two groups, one of which received some general hints on what not to do when solving the problems presented. The second group received no suggestions. The problems varied from abstract puzzles, such as dividing equally an odd-shaped diagram, to constructive work with simple material available. The group receiving suggestions was from 20 percent to 40 percent more efficient. In a variation of the experiment, the 384 students were subjected to two problems of equal difficulty. The hints were given in connection with one of these problems and it was solved by twice as many individuals as the other problem on which no hints were given.

Because the suggestions were, in general, advice against depending on habitual patterns of thought and blind persistence in attempting to solve problems, and because the tasks were best done when the hints are given, it is concluded from the experiments that the type of reasoner most successful in problem solving is the one who can suppress or inhibit his habitual lines of thought to allow free play of new ideas and thought patterns. Of practical importance is the fact that proper training in how to reason tends to improve the problem solving ability of both good and poor reasoners.

The women students were regularly poorer than the men in problem reasoning, even though all the problems were not of a "mechanical" nature, which might be more favorable to men, Dr. Maier says. Those in the group receiving suggestions, however, raised their solving average markedly, apparently benefiting comparatively more from the hints than did the men in the same group. The men's scores in this group rose decidedly, but the rise of the women's scores was much more.

New Invention Speeds Surveying

A SCIENTIFIC device which speeds up surveying and map-making and renders unnecessary a lot of computations has been invented and is now part of the instrument which surveyors call the Abney level. The inventor is Professor John Sammi of the Department of Forest Management of the New York State College of Forestry at Syracuse University.

The Abney level is the most efficient instrument for making maps and running boundary lines for forestry purposes and Professor Sammi has made it still more efficient. In fact, it will now solve problems in geometry for the surveyor that only the human mind was believed able to do, leaving only a few resulting calculations which can often be made mentally. The new device consists of an extra set of graduated marks inscribed on the metal face of the arc of the Abney level. The instrument has always had one set of graduated marks which are not disturbed by Professor Sammi's set. His set is simply inscribed above the old and an additional indicator added to the movable arm of the instrument.

By means of Professor Sammi's device it is now possible to measure to any fixed point on a slope of land and find the horizontal distance to the point by consulting

the graduations on the arc of the level. It is necessary to have this horizontal to find out the height of the point on the slope, a feature essential in making topographic maps. It was not possible to determine such distances except by the use of a specially graduated tape or without using tables before this improvement in the Abney level was made.

Metallurgy of Watch-Making

H. W. GILLETT, director of Battelle Memorial Institute, Columbus, Ohio, has announced the establishment at the institute of a research project sponsored by the Elgin National Watch Company, for the study of the metallurgy of watch-making.

Various alloys are used in watch parts, but they have remained the same for many years. Metallurgical advances that other industries have developed and applied have been singularly lacking in the horological industry. Improvement and standardization of the metal in watch parts are the primary aims of this project.

The Elgin National Watch Company, in the spirit of the word "national" in its name, has developed the manufacture of its own parts rather than relying on foreign sources. It is thus in a position fully to utilize metallurgical research developments and to work out new alloys especially to meet their particular requirements.

James L. Gregg and A. W. MacLaren, metallurgists, and H. W. Russell, chief physicist, have been designated by Doctor Gillett to work on this research program. —*A. E. B.*

Renewable Point Fountain Pen

ONE of the most interesting recent developments in fountain pens is that of the Esterbrook Steel Pen Manufacturing Company of Camden, New Jersey. This company has not only developed a pen which makes use of its long-famous steel points but has added the further feature of renewability of points.

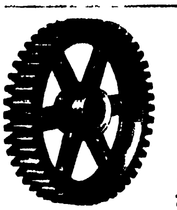
To outward appearance the Esterbrook fountain pen is much like that of any ordinary make. The point, however, is of a new steel called Duracrome, which was developed by the company. This new steel has a platinum-like appearance and takes and holds a finely tempered point.

To suit the handwriting of various persons these points are mounted integrally on a plug which screws firmly into the barrel of the pen. This interchangeability permits the purchaser to choose any point he desires and eliminates the necessity of returning the fountain pen to the factory for repairs. The pens complete cost from one dollar up, and the new points 25 cents.

POSSIBILITIES OF ELECTROSTATIC GENERATORS

(*Continued from page* 134)

that the current from the sprayer is continuous and not a rectified one, in which case the efficiency will be appreciably smaller. The streamers from pointed electrodes are generally considered as a sort of corona involving an insignificant loss of energy, but this view is erroneous. Such a



discharge is very concentrated, approximating an arc in intensity, so much, in fact, that the heat evolved sometimes imposes a limit to the use of points.

In the absence of a detailed description, the performance of this sensational generator can not be closely determined and the actual results may be different from those I have indicated, but not greatly so. While the energy supply may be increased by raising the tension of the sprayer and increasing the number of the discharging and sucking points, there are limitations in this respect and it is perfectly evident that, no matter how big, such a contrivance is nothing more than a toy compared with the commercial machines employed in the transformation and transmission of electrical energy.

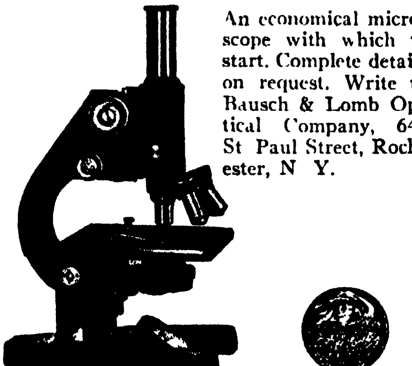
In view of this, and the low efficiency, its application will be confined to scientific experiments in which useful results may be achieved either by a feeble working current under high tension or by successive explosions. The latter method seems more promising because under proper conditions it is possible to discharge the spheres in a time interval incomparably shorter than that consumed in charging them and so amplify enormously the intensity of the actions.

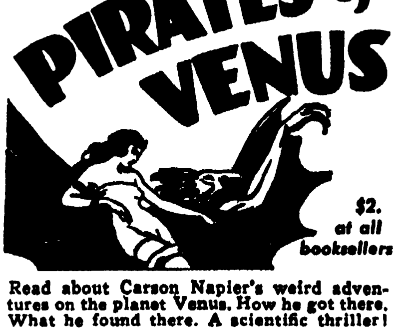
Any device depending on static electricity carried by a belt will fail in damp weather and will have to be operated in a closed space in which the air is properly conditioned. Also, the belts are apt to deteriorate rapidly through the action of ozone, nitrous and nitric acid produced by the point discharge.

ALTHOUGH there is nothing radically new involved in the construction and working of this high voltage generator, it is, nevertheless, a distinct advance over its predecessors, the result of a scholarly effort towards producing an instrument suitable for scientific research. I think though, that whatever can be accomplished with it by virtue of the continuity of action, can be even better achieved by the use of cosmic rays. Moreover, the time consumed in the passage of a charged particle from one to the other end of the tube is so brief that it makes practically no difference whether the current is direct or alternating. In availing ourselves of the latter we are doing away with all the limitations as to voltage and strength of the current and, consequently, the intensity of the effects which it is the chief object to produce.

As far back as 1899 I made experiments with 18,000,000 volts and in some tests I was able to pass a current of 1100 amperes through the air. With my transformers a potential difference of 30,000,000 volts, or more, could be easily obtained and in the present state of the technical arts a tube or other device capable of taking up very great energy might be manufactured. I do not say this in disparagement of electrostatic generators; on the contrary, I believe that when new types are developed and sufficiently improved a great future will be assured to them.

At first thought it might appear that the performance of such a generator could be doubled by using the free side of the belt for carrying away electricity of opposite sign. In this case the repulsion on one side of the belt would be balanced by the attraction on the other so that, theoretically,





the spheres could be charged without expenditure of power. But this is contrary to fundamental laws of nature and it may, therefore, be safely inferred that such a plan would not work.

Static electricity may be eventually harnessed for driving motors and this prospect is attractive on account of the enormous power output of such a machine at very high voltages. The efficient generation and control of these is the chief impediment in this direction. As an interesting experiment the two units of the generator described might be separated and so an electric drive improvised. It would be operative but inefficient.

WHILE it is quite evident that exceptionally favorable conditions for accurate observation will be realized in this instrument, it is highly probable that the attempts to smash the atomic nucleus and to transmute elements will yield results of doubtful value. Certainly, much of the ingenuity and skill now devoted to these illusionary tasks might be better employed. The nucleus is a neutral body consisting of tightly packed particles of the same kind which were originally positive and negative. When the body is smashed the particles again acquire their charges, without distinction, and instantly form neutral pairs so that we have nothing for our pains. It is folly to expect useful results from transmutation brought about through such bombarding of targets. If anything of considerable practical value is ever achieved in this direction it will be by the use of a quasi-intelligent agent causing a sorting and regimentation of the particles and their orderly arrangement as required in the formation of a new structure. Such a power is possessed by a catalist and it will be eventually harnessed and controlled successfully for all sorts of purposes.

Author's note: Reference to page 134.

The required increment of density can be determined by a simple calculation At the spraying points, due to their constant action, there can be no change in the value 1 8333 found before, but from there on the density will increase and at the very top of the charged area it may be 1 8333 + a Since the law of variation is quite immaterial to this argument it may be assumed that the increment is proportionate to the distance from the spraying points, especially as this is most likely to be the case. Under such conditions, a transversal strip of the belt one centimeter long and at a distance X from the center of the sphere, will contain a charge

$q=120(1\ 8333+a\ \frac{d-x}{d-r})$ e.s u Hence the repelling force exerted by the charge Q on the terminal will be

$$F=\int_r^d Qx120(1\ 8333+a\frac{d-x}{d-r}\cdot\frac{dx}{x^2}$$

This integral can be readily solved by expanding and yields the value

$$F=2756352+1088367a \text{ dynes}$$

The mechanical work at the normal belt speed of 3000 centimeters per second will, consequently, be equivalent to

$W=0.8269056+0\ 3265101a$ kilowatt seconds and must be equal to the electrical work of the machine with an overflow current of 0.00022 ampere under a tension of 5,000,000 volts, namely, 1 1 kilowatt seconds for each terminal so that

$$a=\frac{1\ 1-0\ 8269056}{0.3265101}=0.8364 \text{ electro-static units}$$

With this excess density and distribution of the charge as set forth, the net power of both belts, expressed in electrical units, will be 2.2 kilowatts which is exactly the performance of the generator with the overflow current of 0 00022 ampere and terminal tension of 10,000,000 volts. It is evident that just as water finds its level so this balance is instantly established under all working conditions and is effected by a varying slip of the charge; that is to say, by reduction or increase of its translatory velocity according to the changes of the load.

Books SELECTED BY THE EDITORS

STEEL TRAILS—THE EPIC OF THE RAILROADS

By Martin D. Stevers

A NEW book on railroads has been needed for the last 40 years. While this one is not quite as pictorial as we would desire, still there is a great deal which the layman can absorb with profit. The writer gives us the lure of the railway when he expatiates upon the climb from the ground to the locomotive platform, which seems to be an awful climb yet in reality is only a few feet, with a brawny fireman to help you over the last lap. Corners are constantly being cut in railroading and an engineer who will not conserve his sand will soon be brought to book. There is no business in the world as complicated as freight rates, yet when once decided on there is no trouble even with the book-keeping or the collection. There are some pertinent questions which Mr. Stevers does not answer, probably because he would have to get an I. C. C. decision. There are other points which might have furnished interesting reading such as the fact that you pay car fare whether you ride in the locomotive or in a Pullman. The references to bus competition are pertinent and sound. Electrification is a good thing if you can afford it but the steam locomotive will, we think, outlast most of us. $4.00 postpaid.—*A. A. H.*

VALUABLE HINTS TO INVENTORS

By A. F. Gillet

A HANDY volume in which the author deals with such subjects as: Who are inventors?; How to invent; What to invent; When to apply for a patent; How to make a patented invention pay; and so on. 90 text pages plus a comprehensive index. 5 by 7¾ inches.—$1 10 postpaid.—*A. P. P.*

SPECTROSCOPY IN SCIENCE AND INDUSTRY

By S. Judd Lewis, D.Sc., F.I.C., Ph.C.

THE author of this book has packed into its 91 small pages as much solid material in available form as is contained in many books five times its size, and this material is practical, not vague and general as material in too many treatises is. Its scope is the use of the spectroscope for practical problems in chemistry and industry, with a few digressions. The chapter headings tell the story: Elementary Principles; Spectroscopic Equipment (types of spectroscopes); Spectra (types of); Spectrum Analysis (of materials); Quantitative Spectroscopy (for minute traces); Industrial and Scientific Applications (metallic analyses, discovery of elements, organic substances); Spectrophotometry; Absorption Spectroscopy and Applications. There are 41 figures including ten splendid plates of spectra. A valuable pocketful. This compact work and its contents are well worth knowing no matter what use the reader has for a spectroscope.—$2.00 postpaid.—*A. G. I.*

GOD AND THE ASTRONOMERS

By William Ralph Inge, K.C.V.O., D.D., F.B.A.

THE famous Dean Inge, whose name is said to rhyme with wing, goes to the mat once more, this time with those of the astronomers who believe that the universe is being run down. He is not content to let the astronomers answer the problem alone, and his book is a long discussion of the philosophic aspects of the problem as they bear on religion. Those who do not like the idea of living in a gloomy universe that is not winding itself up while it runs down will gain much comfort from the dean's talks—especially if their beliefs in scientific matters are based merely on their wishes—$4.20.—*A. G. I.*

ELECTRIC METERS

By Richard R. Ranson, B.S., E.E., Exp. Dept., Cutler-Hammer, Inc.

AN elementary text on electric meters, in which the reader is given not only the fundamental details of various types of meters, but is also told how to use and care for them. This book is eminently practical in scope, and will be found useful to testers and operators in electrical work as well as to the student.—$2.15 postpaid.—*A. P. P.*

THE FUTURE COMES

By C. A. Beard and G. H. E. Smith

THIS 170-page book is a study of the New Deal—an analysis of the present recovery program. The senior author is familiar to the reading public as the author of "The Rise of American Civilization" and his thesis is that history does not repeat itself—we never return to conditions as they were and must always forge new tools and new methods to fit newly arising circumstances. The authors see the present as a pivotal point in American history. Their analysis is packed with facts and makes pleasant, easy reading.—$1.90 postpaid. —*A. G. I.*

THE SHAPE OF THINGS TO COME

By H. G. Wells

IT is a sad and gloomy picture of the future of those of us now living which Mr. Wells paints in his newest book. Read it and commit suicide—if you believe its predictions—is this reviewer's advice, for you have little left to live for. The Hoover depression is to last 30 years, by the end of which civilization will have sunk to a shadow and a shambles. Europe's horrible next war (1940-49) will be partly the cause of this but not the primary cause, which is our intellectual deficiency—our inability to understand what is the matter with us. Mr. Wells proceeds to tell us what is the matter with us.

After the European War with its gas and germ methods, awful air raids on civilian populations, and a ghastly two year plague which halves the world's population, comes world impoverishment, disintegration, chaos, hunger, filthiness, decadence—New York City abandoned in 1958, Radio City falling down from disrepair, Detroit producing only 1000 cars a year. At last, in 1965-75, comes the recovery of prosperity and the organization of the Modern World State (somewhat socialistic). We then see a picture of what a Better World might be if only we humans were not such fools, according to Mr. Wells.

Ho hum—this is Mr. Wells at his worst and best. If you really enjoy self-induced shivers read this book, but if you are already worrying about stocks, give it to some enemy. But there is a lot in it that is well worth thinking about.—$2.70 postpaid.—*A. G. I.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar

Remarks on Protecting Intellectual Priority

BY E. H. WESTLING

LOOKING back over the April 1933 number of SCIENTIFIC AMERICAN, page 219, I found a highly interesting article on a method of proving priority of inventions. For over 20 years, however, I have used a procedure which I consider much better than the one described. It has the advantage that you can open the letter and show it, if you want to, and have as many duplicates as you see fit. As follows, then:

You write out, as completely as you wish, all you want to say about your invention. Have your friends, as many as you desire, witness the papers. But what I now shall say will demonstrate that no witnesses are really necessary, as the instrument as such is a self-contained, authentic witness. There are two ways, both incontrovertible, and iron-clad, as it were:

1. Have all your writing on one sheet of tracing paper, and then make a blue-print. Next, fold the blue-print, with the white side out, sealing the edges with a gummed label or two. Then use no envelope, but write the address and put stamps on the outside of the blue-print itself and mail it to yourself, or to anybody else. The address on the outside is not important, but it is essential to have the Post Office cancellation stamp on the instrument itself. It is self-evident that the question of whether it has been opened or not will never arise. When the document was sent through the mail, it already was a blue-print.

It is entirely impossible to send an empty blue-print through the mail, then make lines on it with acid, or the like, pretending that such lines were there when the blue-print was sent, because the microscope will show the fraud.

It is possible, however, to send a white paper through the mail, then impregnate the paper with blue-print mixture, and make a blue-print, still retaining the Post Office mark on the other side. But that is very difficult; perhaps more so than making counterfeit money. The microscope will show that the document has been wet, and then dried again, after the postmark has been stamped on. However, to avoid even this possibility, a notary public may stamp the blue side of the paper, before mailing.

2. Instead of making a blue-print of your brain-child, take a photograph of the description and drawings of the same, and make a print on one of those postcards to be had at any photographer. Address the print, put a stamp on, and send it through the mail. Never mind if the writing can not be read without a magnifying glass. Such can easily be obtained whenever you need it. And it might be of advantage. Postal employees who sometimes read those cards would not take the trouble, or have the time, to hunt up a magnifying glass.

Obviously, there is no need to register such a letter or card. But there is nothing to prevent it.

And finally it should be remarked that the generous offer of the SCIENTIFIC AMERICAN to store such documents is of great value to the inventor. He should also avail himself of that safeguard.

Government Radio Control

GOVERNMENTAL control over radio broadcasting operations in Denmark, which ranks first among nations in the number of receiving sets in proportion to population, is said to be giving complete satisfaction. Furthermore the control system is self-supporting financially, says the Department of Commerce.

Danish broadcast programs are controlled by a supervisory board of 15 members which accepts suggestions from civic organizations which have been formed for the purpose of seeking an improvement in radio programs.

Receiving sets are licensed at about $1.75 a year and the broadcasting monopoly receives the entire sum. In most European countries the government levies a tax on receiving sets.

There is about one receiving set for each seven persons in Denmark, while in the United States the estimate is one set for eight and a third persons.

Paint Not a Trade Mark

IN *ex parte* Potosi Tie and Lumber Company, First Assistant Commissioner Kinnan held that the company, of St. Louis, Missouri, is not entitled to register, under the Act of 1905, as a trade mark for telephone, telegraph, and electric power poles, the mark described as consisting of a silver colored coating applied to the transversely cut ends of the poles.

The ground of the decision is that this painting would not function as a trade mark.

In his decision, the First Assistant Commissioner said:

"The cut ends of fence posts permit the water to enter lengthwise of the grain of the posts to a greater extent when the posts are in vertical position than when the water merely strikes the sides of the posts . . it is believed the public on seeing the posts with painted ends would consider the paint applied for protection rather than for trade-mark purposes and would not get the impression of trade-mark significance."

Shellac Substitutes

IT has been directed by the Federal Trade Commission that Acme Shellac Products Corporation of Long Island City, New York, shall discontinue advertising and selling its products as "Shea-Lac" when not made from shellac gum dissolved in alcohol or when shellac gum is not the predominant element.

Exception to this order is permitted if the word "Shea-Lac" or any other word which in appearance or sound simulates the word shellac, is accompanied by the word "substitute," or by "other apt and adequate words, in equally permanent and conspicuous lettering, clearly indicating that such product is a substitute for genuine shellac."

The American Flag for Advertising Purposes

THE Legation of the United States at Prague has been advised by the Ministry for Foreign Affairs that the Ministry of Commerce has taken measures necessary to cancel from the register all trade marks and marks which contain the American flag or emblems. It is further indicated that proceedings would be brought against firms which use the American flag in advertising in direct contravention of the Czechoslovak law.

Argentine Trade Marks

THE Argentine Supreme Court has just handed down a decision to the effect that foreign language trade marks registered in Argentina may be re-registered when they expire.

Several months ago a law was passed requiring trade marks to be registered in Spanish or a dead language, exception made for proper names. Shortly afterwards, a firm applied for re-registration of its French trade mark which had been obtained prior to the passing of the new law. The application was denied because of its foreign language features. The case, which was appealed, finally reached the Supreme Court which rules that the new law was unconstitutional as regards its application to trade marks already registered at the time it was passed. In his decision the Judge stated that trade marks constituted acquired rights and are consequently considered as private property, which is rendered inviolate under Article 17 of the Constitution. This decision is particularly welcome to foreign companies whose trade marks are of definite value.

Danish Patent Statistics

A TOTAL of 2530 patent applications were filed in Denmark in 1932. During the same year 1661 patents were granted, divided by country of domicile of the patentee as follows: Denmark, 519; Norway, 53; Sweden, 134; Germany, 372; France, 48; Austria, 21; England, 141; United States of America, 165; other countries, 208.

At the end of 1932 there were 6899 patents in force in Denmark compared with 7109 at the end of 1931.

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NINETIETH YEAR — ORSON D. MUNN, Editor

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Cover

PARTICLES smaller than about 1/100,000 inch cannot be seen clearly (resolved) by any microscope, no matter how much it magnifies, but the presence of particles down to about 1/4,000,000 inch can be detected with any ordinary microscope by throwing on them a powerful beam of light from one side. Such equipment as is shown on the cover constitutes the ultra-microscope. (Photo by Granccl Fitz Studios, courtesy Bausch and Lomb.)

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ACROSS THE EDITOR'S DESK

IN the future, even more than in the past, readers of SCIENTIFIC AMERICAN are going to be kept in touch with the events of science and industry through the thoughts of men who have achieved prominence in their respective fields. The editors are aggressively following a long-standing policy of obtaining articles only from unimpeachable sources, thus assuring the reader of the authenticity of the material. Some of the articles are noted in the box at the right; others are in preparation. For example: The question of tariffs and their effect on industry is one that has far more than political implications. Two authorities on the subject have indicated their willingness to write on opposite sides of the question, one stating that he will prepare his material after we obtain the definite promise of the other. Negotiations are now underway; we can not tell you more at this writing, but we promise that the articles will be forthcoming, and that they will be well worth waiting for.

●

A MAN claims that he is the father of one of a pair of twins, but not of the other; a mother contends that she has been given the wrong baby to bring home from the hospital; a man denies being the father of an illegitimate child when accused by the mother. These actual cases offer excellent opportunities for using blood group tests in an attempt to arrive at the truth. The question "whose baby?" is one with which the courts of the world have struggled from time out of mind. Even Solomon had this problem to solve. Now science appears to be approaching a definite basis upon which such a question may be answered to the satisfaction of all concerned. Prof. Laurence H. Snyder has prepared for us a comprehensive article, to appear next month, in which the whole story of determining parentage by blood group tests is told in an interesting and informative manner.

●

THE phrase "pushing back the frontier" usually connotes progress toward national prosperity, but when applied to our method of cutting trees for newsprint paper, it has a diametrically opposite meaning. We have pushed back the newsprint-forest frontier into Canada and it is becoming more and more apparent that another source of supply must be found to meet the huge demand. Dr. Charles H. Herty has found it in young—and otherwise practically worthless—southern pine. His article concerning this development, scheduled for our May issue, not only gives the economic side of the subject in strikingly complete fashion, but also is exceptionally interesting *per se*, and especially to Dixie. Southern pines may yet bring the south "out of the woods" with an industry of gigantic proportions.

NEXT MONTH

¶ Laurence H. Snyder, Professor of Zoology, Ohio State University, will write on the determination of parentage by blood tests.

¶ Sources of paper pulp constitute a vital problem to the newspaper industry. An article by Dr. Charles H. Herty will tell of a vast potential supply of pulp that has hitherto been overlooked.

¶ Rev. Joseph Lynch, S. J., contributes a highly informative article on the work of seismologists, written for the layman.

COMING

¶ Charles F. Kettering, Director of the Research Laboratories of General Motors, will write on the necessity of business managers getting the research point of view.

¶ Sterilization of the mentally unfit and criminally insane will be dealt with in two and possibly three articles, prepared by authorities.

¶ How important is foreign trade to national recovery? We are now negotiating for two articles on this question, and expect to present them soon.

●

PARALLELING, in some respects, the article on paper-pulp from southern pine, mentioned above, is another that we expect to present next month, and which tells of experiments now being carried out with the idea in mind of increasing the rate of growth of trees indigenous to the United States. This work, being done by the Institute of Forest Genetics in California, will have a direct bearing on every phase of our daily life in which wood enters. Not only faster growing trees, but tall straight trees, disease and cold-resisting trees, and fine-grained, knotless trees are the aim of the Institute.

●

WHEN a particular phase of pure science is being discussed, it is usual for some hard-headed, practical person to ask the question: "Of what material use is all this theory and experimental work that appears to have no definite objective?" Sometimes the answer must be: "None that we know of as yet," because by the very nature of pure science research, practical and utilitarian ends do not enter the consideration. But in other cases it is possible to point out very definite results of pure science, and seismology is a case in point. In our May issue Rev. Joseph Lynch, S. J., Director of the Seismic Observatory at Fordham University, will give two definite pictures of seismology. The first is of the workings of the instruments of the science, with an explanation of how they function and what they tell, and the second is of the practical ends which are attained. The student of science and the aforementioned hard-headed utilitarian will both find much of interest and value in this discussion.

●

BECAUSE of the growing interest in photography—not on the part of the "snap-shotter" but by the serious advanced amateur—we are planning a series of articles on this subject for early publication. The rapid advance of photographic technique in the last few years has opened a vast field of operation for those whose desires are for something more to do than just "push the button." More of this later.

Orson D. Munn

Editor and Publisher

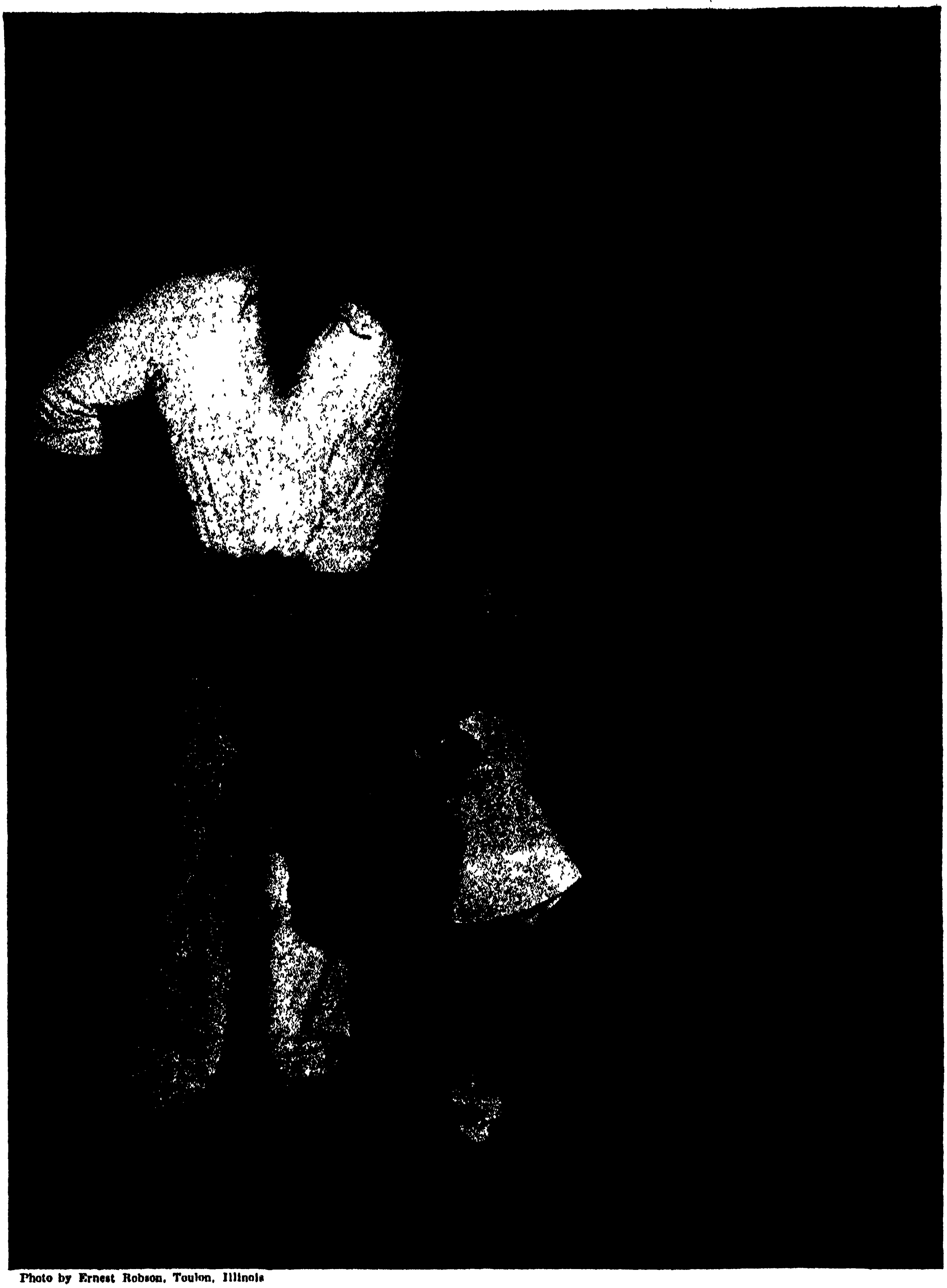
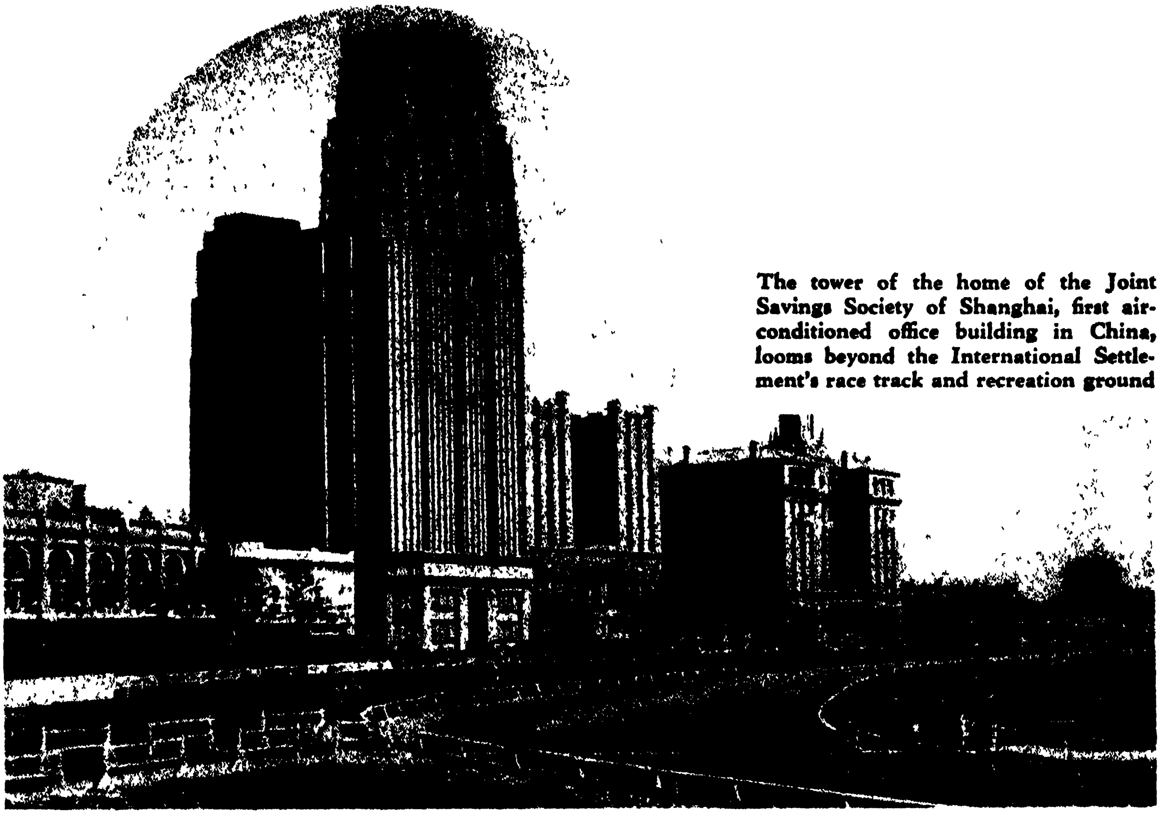


Photo by Ernest Robson, Toulon, Illinois

HUMERUS, HUMERUS, FEMUR, OF MAMMOTH

FRED KELLER, Kewanee, Illinois barber, has the instincts of a scientist, for when he stubbed his toe while wading in a river he quit fishing to investigate and discovered a fine skeleton of a mammoth. Mastodon and mammoth skeletons are not so rare as some believe—hundreds have been found and it is said that there is one in every swamp, but good ones, well preserved, are not common. Many otherwise good specimens have been ruined by amateur excavation, as some crumble when exposed to the air without special treatment. It is best to cover up such finds and call in a scientist.



The tower of the home of the Joint Savings Society of Shanghai, first air-conditioned office building in China, looms beyond the International Settlement's race track and recreation ground

China Modernizes

By WILLIAM S. SHIPLEY
President, York Ice Machinery Corporation

MENTION China to the average American citizen who has never traveled abroad, and there immediately comes to his mind the picture of a far-off, half civilized country, vaguely located "somewhere East of Suez," where strange and mysterious things happen; a land of unending wars and counter-wars, of fierce hatreds and quick-flaming passions; a land of quaint, picturesque cities teeming with humanity, full of queer sights and queerer smells, where furtive, shadowy, queued figures scurry through dark, narrow alleys, with now and then the flash of a jade dagger in the dim light of swinging colored paper lanterns.

This is the China of the movies. It would indeed be difficult for one who carries in his mind's eye such a picture of China, to get into that picture the modern steel-and-concrete, 22-story structure which has recently been erected, in the International Settlement district of Shanghai, as the home of the Joint Savings Society of Shanghai. Somehow those unfamiliar with present-day China do not find it easy to associate that country with a modern skyscraper, rising to a height of 265 feet from the sidewalk to its topmost pinnacle--a building of architectural beauty and refinement of design that would be a credit to New York or Chicago or San Francisco. And still more difficult is it for most of us to fit into our conception of China that most recent product of western civilization: air conditioning.

YET in this ultra-modern banking structure was installed, by the engineering staff of the Shanghai Division of the York Ice Machinery Corporation, an air-conditioning system as complete and as up-to-date as any to be found in America. In fact, it is perhaps the most complete system of its kind yet installed outside the boundaries of the United States.

The building, designed by a Czecho-Slovakian architect who is considered a leading member of his profession in Shanghai, is more than an office building, since it is intended to serve also as an apartment hotel for both permanent and transient guests, as well as to serve the needs of the Joint Savings Society of Shanghai. The latter is a Chinese owned and operated institution for savings. Its capital stock is held by a number of large Chinese banking institutions that make use of the Joint Savings Society's facilities in lieu of savings departments in their own banks.

In this building, the vaults, located in the basement and sub-basement, are supplied with fresh, pure air, automatically kept at the right temperature and relative humidity for comfort. The main banking hall, also in the basement, is likewise air-cooled and conditioned, as are the main lobby and the dining room and lounge on the second floor. Separate units cool the air of the grille room on the 14th floor, keeping the air washed clean of impurities and properly dehumidified. Other units take care of storage rooms used in connection with the hotel kitchen and pantry service on the second floor, and supply constantly cooled and conditioned air to special refrigerating chambers located on each floor from the third to the fourteenth. The system also supplies cold drinking water for each of these floors from a central water-cooling system in the sub-basement.

Shanghai, scene of the International Settlement, where many American, French, and British firms have established headquarters or branch offices, is today the principal customs port and clearing house of China's world-wide

"Many hands make light work." Skids or rollers are seldom used in China for even the heaviest work. Plenty of coolies are always available to do any job

foreign trade. Due to the security of life and property in the International Settlement of Shanghai, and also because of the fact that each nationality represented in Shanghai is under the protection of its own national courts and laws, the city has become the headquarters of practically all foreign firms doing business in China.

THE city, as now constituted, includes the International Settlement, which takes in the original British, American, and Japanese concessions, now consolidated into one unit under a Municipal Council. Adjacent to the International Settlement lies the French concession, governed by a French Council, but on the order of a French colony, subject to the home government. Beyond this lies the Municipality of Greater Shanghai, better known as the Old City, or the Native City.

Shanghai has been aptly termed the Paris of the Orient. It is indeed a city of brilliant, flashing color and unending drama, the scenes of which change with kaleidoscopic swiftness, from the endless variety of wares to be seen in its fascinating shops, along Nanking Road—the "Champs Élysées" of Shanghai—to the unique, hand-wrought native curios so alluringly displayed to tempt the tourist as he goes ricksha-ing through "Pig Alley," the local name for the last street of the International Settlement before you come to the Old City—that ancient section of native Shanghai, whose narrow, dim alleys and quaint customs have remained unchanged since before the days of Rome.

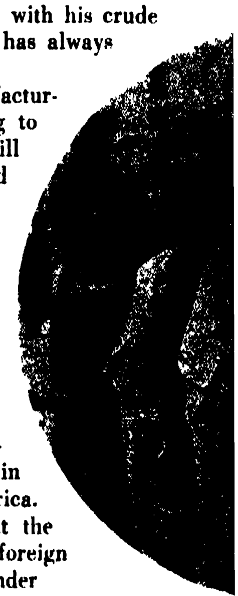
Yet the part of Shanghai which is the International Settlement has its modern aspect. It has its clean, well-paved streets, its street cars, its motor cars. It has its great department stores too, with their modern open-air ground-floor dining rooms and roof-garden cafes. In size, variety, and quality of merchandise, these stores are fully comparable with many of the larger department stores of our American cities.

To visit Shanghai, and to live there for any length of time, is to discover that it is a city which combines the modern with the ancient in a most fascinating way, a city whose people are living their daily lives and carrying on their daily business in much the same way as we of the western world conduct our affairs, yet according to customs and traditions that have come down to them, from father to son, through countless generations. For China—the real China—is centuries old.

But there is a young China today, a new generation of young men in China, who in recent years have grown more venturesome, and who have allowed themselves to come into closer contact with other races and to come under the influence of foreign ways and customs. Today they are slowly, gradually, building a scientific and industrial system which is establishing new standards of living—standards that seem more alluring to the younger China than do the age-old traditions and customs which they have inherited from their honored ancestors.

One senses this change in their apparent eagerness to emulate and copy American ways and methods; in their earnest desire to acquire something of that material prosperity which they have seen in their contacts with foreign business men and business enterprises in China, and particularly with Americans. This is largely responsible for the steady growth in China's trade with foreign nations, and this, too, accounts for their eagerness to import American-made products, even though many such products are, to them, new, unknown, and wholly strange.

Despite this willingness to accept American ways, it was no easy task to introduce into China the American innovation of air that is mechanically washed, purified, cooled, and regulated as to temperature and humidity, before it can be breathed with safety and comfort. At first, the native Chinese looked with suspicion on all things mechanical, preferring to do things as they had been doing them for centuries, often in ways that seemed crude and primitive from the standpoint of western civilization. Even today, no native Chinese woodworker or carpenter will drive a nail into a piece of wood without first drilling a hole in the wood with his crude drill. It is the way he has always done it—why change?



A coil unit for th
the Joint Savings S
to position by a (

The American manufacturing concern attempting to do business in China will find itself confronted with a situation that is unique, due to political and economic conditions which are peculiar to the country, and to the long ingrained habits of its people.

The method of securing contracts, for example, is different in China from that of America. Owing to the fact that the nationals of each foreign country live in China under their own laws, and conduct their business procedure under these laws, it is impossible to assume that certain conditions are legal, which we in America are accustomed to accept without question. It is not safe to take any business situation for granted in China, or to assume that such and such is the case in dealing with the other nations; some countries have lien laws and some have none, while some nationals have consular courts and others are governed by and subject to the rulings of the Chinese courts. Thus the nationality of the purchaser, the location of the plant, the source of the money supply, and the credit of the purchaser are all factors that have an important bearing upon the making of contracts in China.

In view of these complications, and considering the fact that no lien law exists in China, every supplier of ma-

chinery must employ his own methods of guaranteeing payments. When a contract is secured from a Chinese buyer, it is customary to secure an advance payment of at least 25 percent of the contract price as "bargain money," and another 25 percent or more at time of delivery, in the case of such items as machinery and equipment. As no manufacturer in China can secure a lien on machinery supplied or installed, it is necessary to secure some form of guarantee for the final payments before making delivery of the material. Without going into the intricacies of the Chinese banking system, suffice it to say that the Chinese have a system of guaranteeing payments which gives to the American business man the fullest protection.

AFTER a contract is once made and the "bargain money" paid, it may safely be said that the American concern doing business in China will be able to operate with fewer bad debts than the average firm doing business in America. This may be due to the custom of securing bank guarantees, or shop guarantees, as they are called; or it may be due to the fact that the Chinese business man, as a rule, thinks very highly of his business reputation. In other words, he dreads to "lose face." He will resort to almost any means of securing a reduction from his original price, but he will never flatly refuse to pay a bill which he has contracted, since by repudiating entirely a just debt, he would "lose face" with his business associates. This is one custom in China which reacts favorably for the American business man in his dealings with the Chinese buyers of his products.

litioning plant in
ling being moved
rong-backed coolies

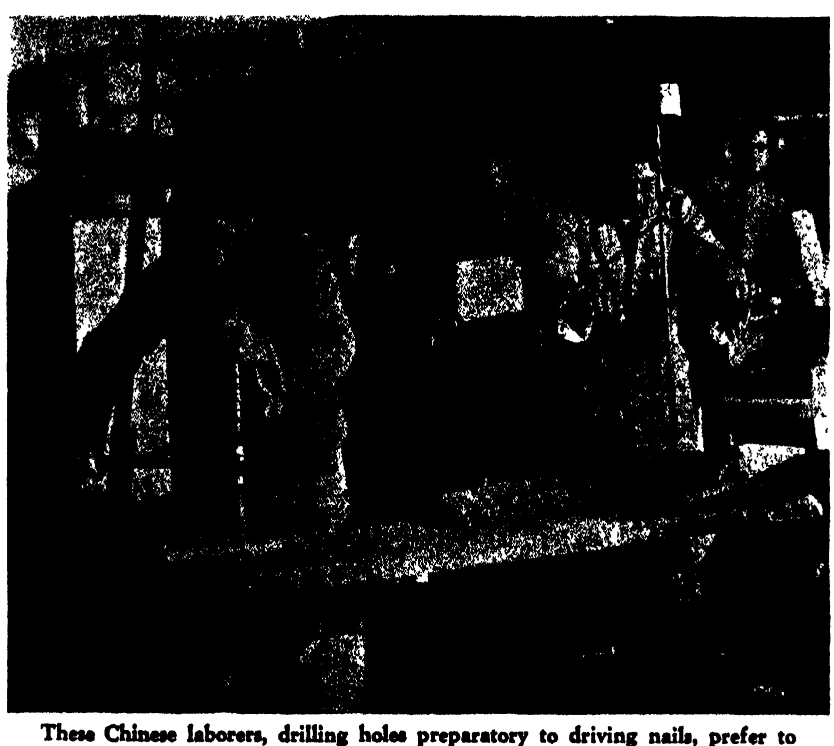
When York first entered into active selling in China, in 1920, the idea of refrigeration for general purposes, much less for industrial or domestic purposes, had not yet penetrated into that country. During the World War, the demand for frozen eggs gave rise to the establishment of a cold storage industry to some extent in China, and from this beginning it was more or less of an uphill fight all the way to the point where the Chinese would finally become truly "air-condition minded," as are the people of America today. But that the people of China are rapidly coming to accept the modern American viewpoint as to the value of mechanical refrigeration is indicated by the fact that more than 250 York machines, with a total refrigerating capacity in excess of 3500 tons, have been installed in China during the past decade. Some of these machines have been located in remote interior cities where few foreigners other than missionaries are permitted to visit.

China is a place where labor is amazingly cheap, but at the same time very inefficient, except in cases where the same routine work can be done over and over again, day in and day out. The mentality of the Chinese workman is peculiar, however, in that once having been shown, and having thoroughly grasped, a principle or a method of working, he will never forget it. Today, the York organization in China has reached a stage where it has developed and trained a staff of Chinese fitters who can install complete plants of the type placed in the Joint Savings Bank Building of Shanghai. And though they still show a preference for their own tools, as against the high-grade special tools provided for them, the fact remains that they accomplish results.

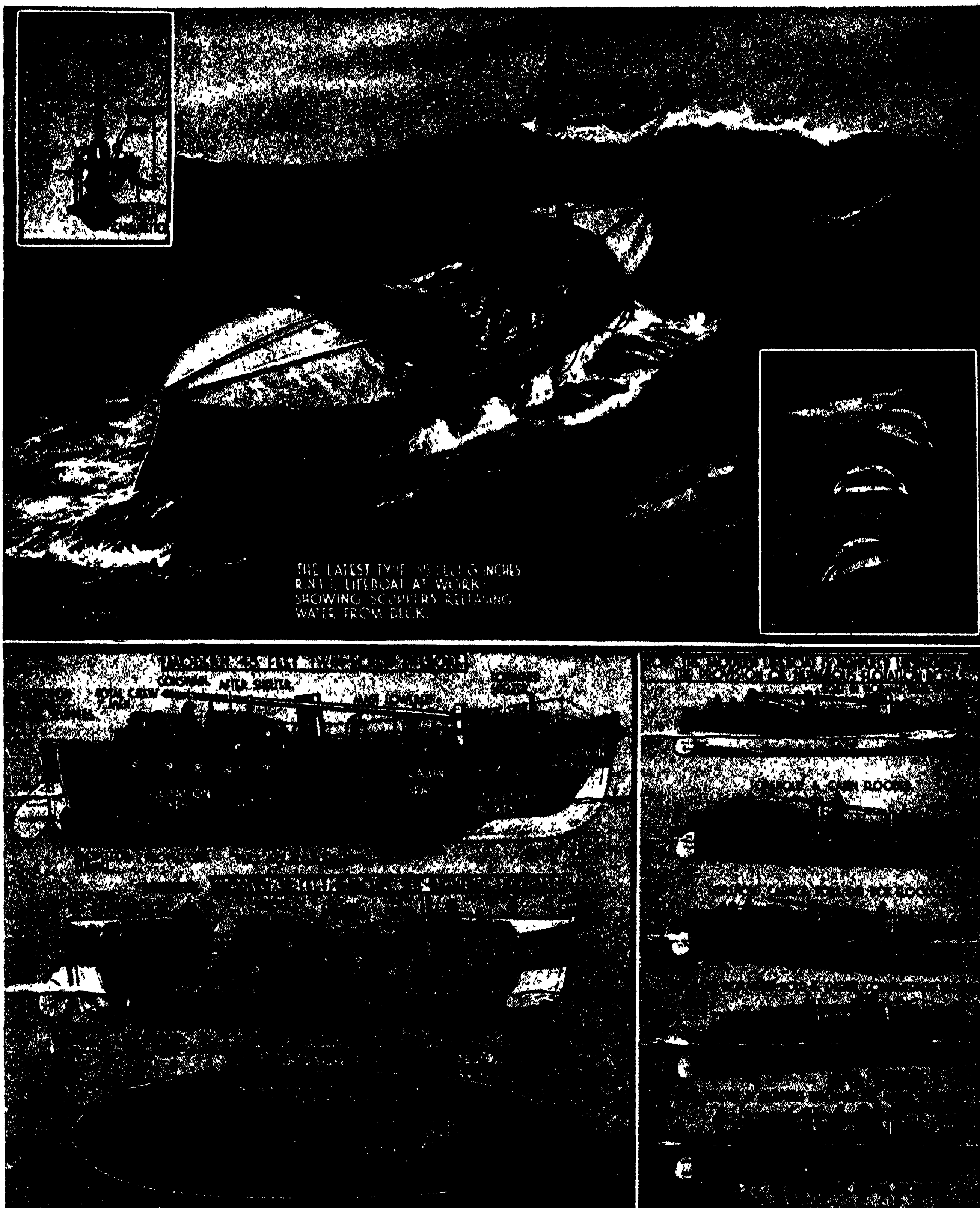
Construction work in the Shanghai plant is performed in practically the same manner as it is done in America, except for the fact that every piece of machinery, even to the heaviest compressor weighing several tons, is lifted by hand and carried to its proper position, rather than moved on skids or rollers. The old adage that many hands make light work was never more aptly illustrated than here, because it is always possible to obtain as many Chinese coolies as may be required to lift anything that is desirable to move, regardless of its weight or bulk.

The Chinese native, as a rule, is not only willing but eager to follow the lead and adapt himself to the manners and methods of his American cousin, not only in his dress and manner and ways of doing things, but in his engineering, fabricating, designing, and producing of machines that contribute to his physical comfort and well being. It took him a long time, comparatively speaking, to assimilate and adapt to his own uses the principles of modern air conditioning. But now that science has pointed out that the motion of air, temperature, and relative humidity are subject to automatic mechanical control and regulation, and are factors which are intimately related to one another in contributing to his physical comfort, we may reasonably expect that air conditioning will find increasing fields of practical application in China.

IF America has taken up the air conditioning of its office buildings, China will take it up; if it is the custom to cool and condition the air of our American theaters, our homes, churches, public buildings, even of our crack American railway trains, we may soon expect to find theaters, and likewise homes and railway trains in China providing the comforts and advantages of conditioned air. If a new American method of making artificial ice, or of using refrigeration in the preservation of foods, is developed in America, we may look for its counterpart in China. For the interests of modern China and the Chinese center today in America, as the nation which points the way, a nation whose leadership China is only too willing to follow if it may lead them to a broader, richer civilization, with its attendant benefits.



These Chinese laborers, drilling holes preparatory to driving nails, prefer to use their own crude drills to which they are accustomed, rather than modern tools



Courtesy *The Illustrated London News*

British Motor-Lifeboats Are Highly Successful

THE old-fashioned oar-propelled lifeboat is rapidly being replaced along the coast of England by modern motor-driven boats equipped with numerous flotation chambers and rugged power plants. Two types of these boats, placed in service by the Royal National Lifeboat Institution, are shown in the illustrations above. In the fleet now in use, there are boats that can free themselves of water by means of scuppers as soon as it comes on board; keep afloat with every water-tight compartment damaged; right themselves in a few seconds if capsized; and continue running even with the engine room flooded. In the upper left-hand corner of the illustration is shown how the air intake pipe for the carbureter is mounted so that it remains well above the water line, even when the boat herself is water-logged. These boats are expensive to build, costing from 15,000 to 45,000 dollars each, but they saved 398 lives in 1933.

OUR POINT OF VIEW

Naval Aviation

ADMIRAL W. H. STANDLEY, Chief of Naval Operations, recently expressed the determination of the Navy "to fight bitterly against any such move as is now contemplated for an independent, united air force. . . ." He said further that the efficiency of the Navy would be destroyed utterly if her air force is taken away from her.

We heartily concur. Moreover, we wish to emphasize the Admiral's statement that the Navy *still* is the country's first line of defense.

For the sake of argument, let us assume that the country would be willing to place the responsibility for coast defense upon an independent air arm and coastal defenses. Enemy ships might operate just beyond range of either, blockading us most effectually. At the same time an enemy air armada might be made ready, with the fleet as its base, that could smash port facilities and transportation lines, thus crippling our food supply systems and causing wholesale starvation—to say nothing of populations wiped out by bombs and gas. Our fleet without its own perfectly coordinated air force—Navy-trained for operation with the Navy—when sent out to meet the enemy, would be so handicapped as to be easily destroyed or put to flight. The enemy's air and water craft, acting in concert as a well-rounded unit, would be more efficient than an unbalanced fleet. And a fleet depending on the operations of an air force over which it has no direct control—an independent air arm—would certainly be unbalanced.

It has been vehemently argued that airplanes have rendered surface war vessels obsolete. Perhaps there may have been some grain of truth in this assertion right after the World War when aviation had just learned much by actual experience and navies were still ignorant of the possibilities of air fighting. Now, things are different. Besides carrying planes, ships have been given highly efficient anti-aircraft guns and have been protected against air bombs. On good authority we know that not even the stacks of some of our latest ships are vulnerable to bombs.

The fleet is still the country's first line of defense, to protect its interests a mile or a thousand miles from shore; and the Navy must have its own air force. Now that we are to have a Navy adequate, as to ships and tonnage, to our national defense needs, it must not be again weakened by this proposed lopping off of its carefully nurtured, lusty, fighting "eye of the fleet" which "knows a ship when it sees one."

The Motorist Pays . . . and Pays

AMERICAN motorists paid over a quarter of a billion dollars to the federal government during 1933 in the form of various motor taxes. To the individual states they paid more than half a billion in sales and fuel taxes, registration and driver's license fees, and other levies. Altogether, the motorist is revealed, by figures compiled by the American Petroleum Institute Committee, as a billion-dollar tax payer.

When the first gasoline tax was imposed in 1919, the total amounted to only a little over a million dollars, and the funds so obtained were used for the direct benefit of the motorist—to finance road construction. There could be no legitimate objection to this use of the money; in fact, such taxation for the purpose was the only logical way to provide for the demands for better roads. But then the federal government recognized the motorist as a fertile—and docile—source of revenue, and it dipped deeply into his pocket without even a pretense that the proceeds of taxes would be used for roads. The ease with which individual states were collecting gasoline taxes opened a huge field for budget balancing, and the motorist paid!

It seems that those legislators who have been responsible for the steadily increasing taxation placed on the motorist are still living in the early days of the automobile, when a car was the plaything of the idle rich and as such was a distinct luxury. The time rapidly arrived, however, when the automobile became an absolute necessity to a large proportion of the people of the country, and this condition prevails now more than ever.

To cap the climax of the whole taxation grab, the additional burden was placed at a time when the motorist could ill afford to increase his expenses. The result was a decided decrease in motor travel and consequently in the purchase of the taxed items. The direct effect on the motor-car industry and those other businesses which depend on the motorist for their livelihood is perfectly plain.

It is high time that one of two things be done: Either reduce the total amount of taxes that each motorist must pay to the various collecting agencies, or make arrangements for the money to be diverted to channels where the motorist will get some direct benefit from his contributions. Either of these two steps would have a marked effect on industry as a whole and are therefore greatly to be desired. To throttle business in such a far-flung field as is represented by the motor car should never be the aim of taxation.

And Every One of Them Will Die

UNTRUTH crushed to earth will rise again. Recently Dr. Herbert E. Winlock, Director of the Metropolitan Museum of Art in New York called local reporters together and before them killed, deader than Tut-ankh-Amen himself, the old story about the death curse pronounced by that deceased Egyptian on all who might disturb his tomb. He pointed out that the man who discovered Tut-ankh-Amen's tomb is still alive; that four out of the five who were present when the tomb was opened still live; that 16 of the 22 who were present when the inner chamber was opened survive; that 20 of another 22 who were present when the sarcophagus was opened have not yet felt the royal wrath; and that not one of the ten who actually profaned the sacred monarch's mummy has met his fate. These are the facts.

And who are dead?

Lord Carnarvon, who was always frail.

Sir William Garstin, who died in 1926 of old age.

Sir Charles Crist, died in 1932, aged 68.

Mervyn Herbert, Lord Carnarvon's brother, who died at 48, and Richard Bethell who died at the same age (perhaps this particular curse works best at 48).

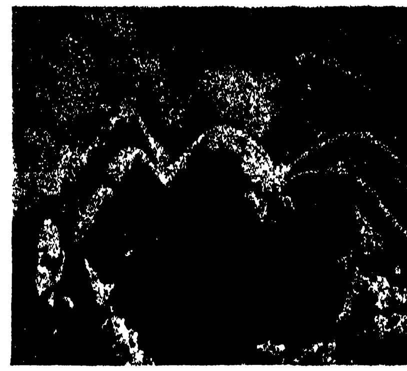
Arthur H. Mace, who died in 1928 of tuberculosis.

Well, out of the number present, largely persons past middle age, or the same number chosen at random on earth, about the same proportion would be dead, would they not? People do die occasionally, even without being cursed.

The fundamental fact in the psychology involved in such cases is, of course, not so much that people really do believe in such things, as that they want to believe in them. It is more interesting.

A cricket calmly devouring the tender parts of a leaf, while the movie camera makes a permanent record of the feast

A cricket stridulating or "singing" by rubbing his wings together



A wolf spider, sitting above his hole, waiting for insects to pass his way

A trapdoor spider about to capture a cricket. Note how the camera has caught the spider in position to make the leap

A trapdoor spider at work on the hinged lid of his home, busily kneading dirt into the web frame which he previously spun

In the center of the picture may be seen the circular outline of the door covering the spider's burrow. The spider is about to raise the lid he so laboriously built

INSECT WARRIORS

By STACY WOODARD

IN the darkness outside our tent on the Arizona desert, near Tucson, the sound of two tiny bodies threshing around on the sand distracted us from our rest. I rushed outside, but at first I saw nothing; then, on closer inspection, I perceived the dim outlines of two insects in a death embrace—a deadly centipede and a Jerusalem or sand cricket.

"Get the lights," I shouted to my helper.

As he hurriedly set up the incandescent lamps, I brought out the camera and pointed its macroscopic lens toward the death battle being waged on the great outdoor stage of the southwest. Quickly I pulled the two warriors apart, separating them about a foot. Immediately the centipede rushed at the cricket and again went about his business of killing his antagonist.

Now the sand cricket, in his small way, is no unworthy foe. His powerful mandibles, had he been able to fasten them in the centipede, would have crushed the enemy. So what did the centipede do, as one of the photographs on these pages shows, but roll on his back, stiffen his body and hold the cricket out of crushing distance. At his convenience, he administered the death-bite to the cricket.

Of course I did not permit the kill to be completed immediately. We had actors on our stage, insects living the intense drama of nature, and I wanted a full half hour of photography; I might never have another opportunity to film this rare scene under natural conditions. So from time to time I pulled them apart, and after each separation the centipede rushed again to the attack, providing, before the final extinguishing of the lights, one of the finest scenes I have ever photographed.

In recording the constant struggle among insects, of killer vanquishing killer, of the eternal struggle for life, I have not always carried my camera into the open. Frequently it has been necessary to set the stage, to reproduce the desert in miniature within a Hollywood movie studio. Some insects shy away from lights, others are frightened by sounds. We not only set the stage, but we also accustomed these tiny warriors to strange sounds and provided for them familiar surroundings in order that they might conduct their amours, seize their natural prey, and fight their battles under our direction amid physical conditions to which they had been long accustomed.

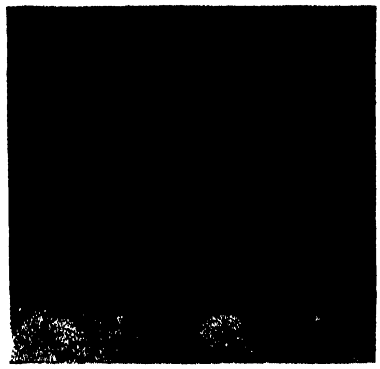
WITH macroscopic lenses, I have paraded hunting wasps, deadly scorpions, the praying mantis, solpugids, warrior ants, desert orbs, trapdoor spiders, wolf spiders, and crickets before my camera, on both indoor and outdoor stages. I have followed at close range deadly battles, waged with an intensity of which few humans are capable, and have staged battles on a stage no larger than a foot square.

One of the most remarkable sequences showed the hunting wasp stalking a cricket, finally stinging him to death. I had tried to get this subject on the desert, but found it impossible to control either the lighting or the warriors properly.

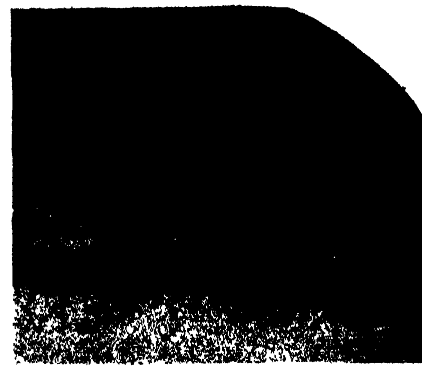
Back to Hollywood I went, to the silence of a sound-proof room. There I built a tiny stage, camouflaging it so that it would look to the little actors exactly like their desert home, complete to the brush and sand. I built a series of runways, all of which terminated in

Photographs courtesy Educational

The author on location in the desert, with camera set up for recording insect battles



A wasp poised over a cricket, after administering the death sting



Two male crickets staging a battle royal over a female; death to one of the combatants will be the result

BATTLE FOR THE MOVIES

a glass-enclosed case. The 12-inch lens peered directly through a glass wall at the battle ground.

After placing a cricket in the case I turned a hunting wasp loose at the back of a runway. She took her own sweet time in crawling forward, but at last reached the case. The cricket being the wasp's natural enemy, the hunter wasted no time, once she came within view, in leaping on the cricket; and there, directly before the camera, she carried out nature's brutal process.

CONSIDER the scorpion—most merciless of fighters. When scorpion meets scorpion, a death battle follows. I took several scorpions from the desert back to Hollywood, and again reproduced their natural conditions. Since the scorpion is a nocturnal insect, I kept the stage dark until two of them actually reached the enclosure. Then we switched on the lights and in the brilliant arena the fight started.

There was no hesitation. Scorpions advance unafraid, each trying mightily to press its barbed tail home between links in the other's armor. This accomplished, he backs off and awaits the death. Then he consumes his foe. Sometimes both accomplish the fatal thrust, and a double death follows in a few minutes.

Oddly, trapdoor spiders are timid, while crickets will walk into death without flinching. The spiders proved so timid that I found it impractical to film them on the desert and again transported an army of these fellows, holes and all, to Hollywood. The first two nights after setting up the apparatus, we waited vainly for them to appear. Spiders are supposed to be unable to hear, but they must have seen the lights and "felt" the motors, for as soon as the cameras were started they would retreat. I solved this problem by keeping a motor running constantly, and after a time the spiders became accustomed to this strange and almost inaudible noise.

Crickets fight each other naturally. In order to get our pictures, I placed several within the enclosure, the floor of which was pock-marked with holes into which they could retreat. As the "inkies" glared on the scene, the males emerged from the hole to "stridulate" or rub their wings together. In this way they sing their songs of love to the females. Often the males would fight over a female, continuing the struggle until one passed from this world.

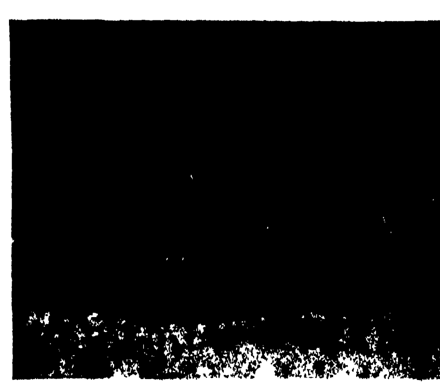
There is no set way of recording these dramas of the world under foot. New processes were evolved as we progressed. Every situation was different. Broadly, it was necessary to know which insects are natural enemies. Then we needed only to bring them together under conditions to which they are accustomed. I did not really direct these combats. Their lives within themselves are dramatic, terrific—for insect eats insect and gives no quarter.

As the sun beat down on the Arizona desert one day, I was recording a tribe of agricultural ants as they went with seeds to their storage bins at the nest. One turned aside. I followed him with my camera. He climbed a flowered plant and crawled out on a leaf where he found a drop of water, tiny yet larger than his body.

These sparkling dew drops serve as drinking fountains for insects. They are the "water holes" of the insect world. I observed him quietly as the camera's motor whirred. He was drinking from the surface. Carefully his mouth parts moved over the dew drop so as not to break the tiny bubble—but in his excitement and thirst he pushed the dew-drop off the leaf. Off it slid, leaving the little worker completely bewildered.

Scorpions locked in mortal combat, fencing for an opening in each other's armor through which the stinger can be thrust

A centipede and a sand cricket fighting; the centipede is holding the cricket at "arm's length" to avoid the powerful mandibles that could cause instant death



The end of the centipede-cricket fight; the centipede has just succeeded in closing his jaws in the final dramatic act

TRIBULATIONS OF THE TROPICAL

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President, the American Association for the Advancement of Science

THE question, "What country is most distinguished in science?" admits of no simple answer. One or another will be found at the head of the list, according to the particular science under consideration and the criteria of distinction which are employed. But the inquiry, "What country is most distinguished in science in proportion to its population?" admits of less debate. Whether measured by the number of men of great eminence, such as Nobel laureates, or the volume and quantity of research publications, no nation, in proportion to the number of its people, surpasses Holland.

The cause of this eminence may well invite the careful study of students of race, education, and government; we are concerned rather with its results in the field of astronomy. Everyone knows the names of the lamented Kapteyn and the still active DeSitter, and the "Bulletin of the Astronomical Institutes of the Netherlands" is one of the most important journals in its science.

THE greater part of this fine Dutch work has been wholly or partly theoretical, for obvious reasons. Neither in latitude nor in climate are the Netherlands well fitted for great telescopes or observing stations of the first rank. Admirable work has been done with modest instruments at Leyden, Utrecht, and elsewhere, but the national situation lends itself especially to the discussion of observations obtained elsewhere, or to more abstruse investigations. The worldwide freemasonry of astronomers has time after time resulted in effective international co-operation, as when Kapteyn in his laboratory at Groningen, planned and supervised the measurement and calculation of the positions of the nearly half million southern stars of the Cape Photographic Durchmusterung. (Some of the actual work, by the way, was done by selected convicts from a nearby prison, who welcomed this change of occupation!)

But Holland has a great colonial empire in the East Indies, in the quarter of the world where observatories are fewest. There is—or was until recently—hardly a single large observatory within the tropics, though excellent solar work was done at Kodaikanal in southern India. The establishment of a notable institution in Java is therefore a matter of no small importance.

The foundation of the Netherlands India Astronomical Society in 1920 was intimately connected with the generous gift of more than 100,000 dollars from a wealthy Dutch resident, Mr. Bosscha, toward the establishment of an observatory. Though many of us have heard little of it, the Bosscha Observatory has just celebrated its tenth anniversary and the report of its Director De Voûte tells a tale of much interest.

Like all modern observatories this is "set on a hill"—more precisely on a mountainside—near the village of Lembang and some ten miles from the flourishing city of Bandoeng where full technical and machine shop facilities are available. It lies on a local ridge 4000 feet above the sea, with a quiescent volcano rising 2000 feet higher six miles or so away.

Courtesy Carl Zeiss, Inc.
The double refractor of the Bosscha Observatory at Lembang, in Java

The latitude is 6° 49′ south, so that the photographs of the telescopes have a curious look to those of us who are accustomed to work in the cooler part of the temperate zone. The polar axis, which as we usually see it is tipped up steeply toward the north, here lies almost horizontal and extends between two piers, the southern a little the higher. To point at the pole—which is so important in northern or southern latitudes—is no longer of any use since it lies in the mist of the horizon. The observer's interest lies rather in the equatorial zone and the region south of it. The northern sky, though equally accessible, is taken care of by other observatories.

Weather conditions seem strange enough to the northern reader. The average temperature varies very little throughout the year—the daily maximum ranging from 73 to 77 degrees Fahrenheit from month to month and the minimum from 58 to 61 degrees. The humidity, even in the daytime, averages from 60 to 75 percent. Just before dawn when the cooler air can hold less water it is always more than 90 percent.

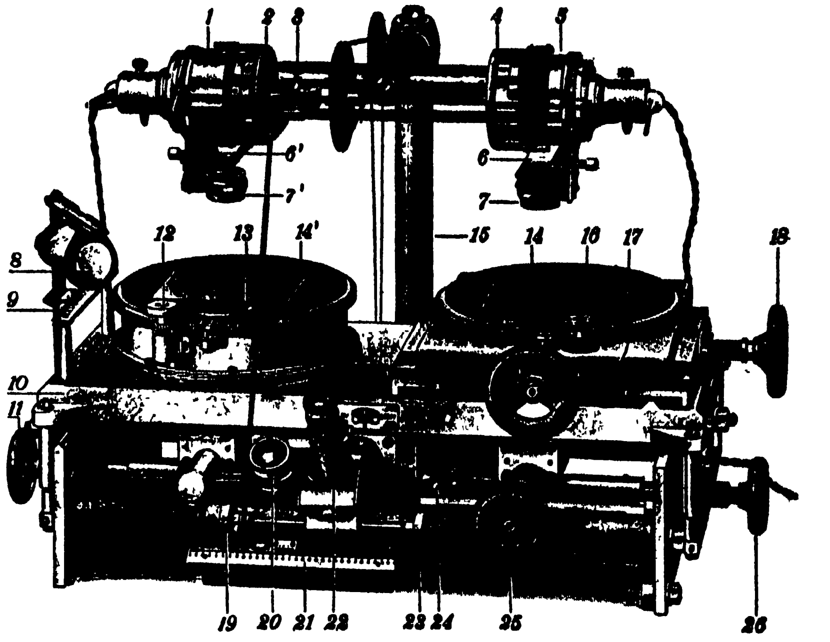
The rainfall is heavy—88 inches a year, two-thirds of it in the rainy season from October to May. This seems very bad for astronomers, but only one third of the rain falls in the evening and at night, and hardly any after midnight when the chance of clear sky is as good in the rainy season as in the dry.

An observer's life under these conditions must be somewhat strenuous, and the care of his instruments too is far more arduous than here. Dew "falls" as soon as the metal of the telescope cools at night and in far greater amounts than in less humid regions, and De Voûte says that "all instruments become dripping wet when exposed to the dew process during the night observations. To protect the lenses from fogging it was necessary to use long dew caps about five times the aperture of the objectives; if they still get wet they are dried by means of an electric hair dryer"(!)

THIS is not all of the tale. Great care is necessary "in avoiding the formation on glass surfaces of fungi which, after some time, cause spots which cannot be removed. These fungi live in moist and dank air". They "secrete an alkaline matter, naturally only in minute quantities, so that only after a long time is its influence on the glass surfaces noticeable. Therefore a regular disinfecting cleaning after some months is the best safeguard. It is the glass surface of lenses and prisms built within the instruments which cause the greatest trouble, where every cleaning demands a readjustment." To cap the climax, "on account of the neighborhood of the volcano, the air generally contains hydrogen sulfide (H_2S)—most of the time so much that it becomes disagreeable—and this excludes the use of reflectors." Silver mirrors would tarnish hopelessly in a few days. The new aluminum coatings should behave better if the complicated apparatus for producing them could be set up in Java.

Finally, the Director remarks casually, "Earthquakes are in this part of Java rather weak, their origin being situated at a great distance in the Indian Ocean. Volcanic eruptions are not precluded, but the position of the Observatory is rather safe because it is

ASTRONOMER



In his article the author refers to "faint objects of large proper motion discovered with the blink microscope." Before this apparatus was discovered the method of search was most laborious. The astronomer took two photographs of the same star field several months apart, and one by one compared each star image with its corresponding image on the second plate. Today the same two plates are put on a blink comparator or flicker microscope and the image of the shifted star at once pops out from among its myriad companions. How is this done? In the (Zeiss) instrument shown above, the first plate (14') is placed on the round table at left, the other plate (14) on similar table at right. Both are illuminated from above. The images of the two plates are picked up by diagonal mirrors within the base and passed to a half-silvered diagonal prism below the microscope (22). The two plates are now in rough coincidence, visible in the same eyepiece, and the use of wheels 17 and 18, with rotating screw 16, completes their perfect coincidence so that now but one star field is visible. Next the illumination is changed so that it illuminates the plates alternately. Hand screw 23 (or 19) does this (note vertical rod connecting shaft to control of illumination cut-offs above). Especially if the same alternation is done more rapidly by motor (note belt and pulley), the single displaced star image lost among all the rest will shift back and forth, blinking or flickering prominently

situated on the most stable side of the volcano, the south."

An astronomer's work at such a station evidently contains a heroic element. There are compensations, though. The small temperature range and the usual absence of strong winds make the air steady and the seeing very good, so that close and difficult double stars have been measured in great numbers.

The principal instrument at the Observatory is a double telescope with visual and photographic objectives of 24 inches aperture mounted side by side. The important double star measures already mentioned were made with the one, and photographs for stellar parallax are being obtained with the other. Only one sort of work can be done at once, but this is no great handicap, for parallax observations must be made just after twilight or before dawn, leaving the rest of the night free for double stars. The cloudy evenings of the rainy season interfere seriously with work on stars in certain parts of the sky, but there remains an abundance to do.

DE VOÛTE has just published the first reports of this work, which is very thorough—20 to 40 plates being taken and measured for each star—and the results appear to be excellent. The most interesting star on which he reports is Proxima Centauri, the faint star discovered by the late Dr. Innes, which shares the rapid proper motion of Alpha Centauri though more than 10 degrees away. His measures give a parallax of $0''.746 \pm 0.006$—substantially the same as that of Alpha Centauri—and fully confirms its relation to the latter. It will take a good deal more observation to determine with certainty whether this faint object is really a little nearer than Alpha Centauri (as indicated by Dr. Alden's measurements made at the Yale Station in South Africa) or slightly farther, as the later measures suggest, so we must wait to learn whether it is actually the nearest of the stars after all.

Most of his other stars are faint objects of large proper motion, discovered by various observers with the blink microscope. They are "good fishing," for among his first dozen he has caught two with parallaxes of $0''.20$ and $0''.21$—adding two more to the short list of stars nearer than five parsecs (16 light-years). Their photographic magnitudes are 11.1 and 12.9, so that one is 1/200 and the other only 1/3500 as bright photographically as the sun. This puts them definitely in the growing class of faint dwarf stars, though they are brilliant compared with Proxima which, measured photographically, is but 1/60,000 of the sun's brightness.

With these cares and duties, and with several smaller instruments to look after, one might expect the time of the small staff to be taken up fully by making and reducing observations. Yet the tradition of theoretical work is not neglected. Dr. Wallenquist, a Swedish astronomer and member of the staff, contributes an excellent "Miscellaneous Paper" on the distribution of stars in clusters. Photographs of a cluster show that the stars are much more thickly concentrated at the center than in the outer regions, but in the middle of the cluster as it appears to us we see not only the central stars but others belonging to the outer layers which lie in front or behind. By an ingenious and simple method our author has allowed for this and finds that the actual space-density of the stars near the center is from 70 to 400 times that near the edges. The brighter stars on the whole are less widely scattered than the fainter ones. This is no accident, but has a physical cause first worked out by von Zeipel. In a fairly close cluster individual stars must at times pass near enough to have their paths diverted by their mutual attraction before they escape from its influence. In the long run such encounters will on the average speed up the stars of small mass and slow down the massive ones. The former, having higher speeds, will get farther from the center of the cluster before the attraction of the whole mass brings them back. From the difference of their average distances the ratio of their masses can be found. Wallenquist has done this for stars of different brightness, and finds differences in mass which are in agreement with the law discovered years ago by Eddington.

Altogether, the work of this little isolated group of courageous and devoted astronomers does the highest credit to them and to the community in Java which supports them. Their brother astronomers in less picturesque climes join in hearty good wishes for the continued success of the Bosscha Observatory.—*Princeton University Observatory*, February 5, 1934.

WORKING and THINKING and EATING

THERE is not much energy concentrated in half a peanut, in a gram of cane sugar, in 1½ grams of white bread, or in 4 grams[1] of the edible part of a banana, yet, little as there is, there is enough in each of these portions to supply the surplusage of energy that an hour of intense mental effort requires.

Indeed, so small is this demand that a housemaid engaged in sweeping and dusting the study of a college professor would expend as much extra caloric energy in three minutes as the professor would expend in excess of his basic needs during an hour of intensive work at his books.

These surprising statements were made by Dr. Francis G. Benedict, the Director of the Nutrition Laboratory of Carnegie Institution of Washington, in summing up the results of an experimental investigation of mental effort as it affects the metabolism of the body, an investigation which he and Mrs. Benedict have recently reported.[2] In effect, the study denies that there is any basis in fact for the popular belief that brain-workers, more than others, require food that, like fish, is rich in phosphorus.

REPORT of this study, recently published by Carnegie Institution of Washington, brings the great work that physiologists are doing in their field of investigation once again to general attention. To grasp the importance of the conclusions they have reached, some information is called for regarding the physiological processes of the body and the methods employed in their study.

Scientists tell us that our bodies are marvelously constructed machines, working with extraordinary facility and efficiency. Viewed as machines, they are of the nature of the engines of industry in which combustion of fuel releases energy which can be put to useful work. The energy required to walk, to run, to swim, to play tennis, to perform the countless activities daily demanded of us, is obtained through combustion of the food that is eaten. Food-stuff is, therefore, the fuel of the body and, as such, the energy-producing power of all the common items in our dietary can and has been determined.

Just as methods have been developed for measuring the amount of energy obtainable from various articles of food, persistent attempts have been made to devise ways of determining how much energy is expended when the body is called upon to perform tasks requiring special effort. It is in these reciprocally related fields of investigation that Dr. Benedict and the staff of the Nutrition Laboratory have been working for many years.

Apparatus used in measuring the energy expended by a subject while walking. The carbon dioxide in the exhaled air is absorbed by chemicals in the rubber-covered can on his back. The operator behind the subject holds two football bladders containing an accurately measured volume of oxygen which is fed into the closed circuit as needed to keep him supplied

Very early in course of his studies, Dr. Benedict found that even when the body is nominally at rest, with its "fires banked," so to speak, energy is being consumed.

The heart, for example, never pauses in its task of maintaining a head of pressure in the blood conduits of our bodies. The respiratory mechanism is constantly supplying us with the oxygen we need and removing the useless and harmful products of combustion. The thermostatic devices by which the temperature of the body is regulated and held constant are always functioning. The white corpuscles of the blood, "scavenger cells" so-called, are forever wandering about, amoebic-fashion, searching for infected tissues and clearing them of bacteria. Then, whether we are asleep or awake, glands are secreting their products, visceral muscles are rhythmically contracting, the nervous system, the master tissue which controls all the functions of the body, is being kept "in tone." In short, the body is a *living* machine which is obliged to expend a measure of energy simply in keeping alive.

The condition of the body in such state, Dr. Benedict has likened to that of a great factory that is awaiting the signal to begin the business of the day. The building is at a comfortable temperature, steam is up in the boilers, engines are purring, shafts and wheels and pulleys are idly turning, the operators are at their stations, all is in readiness to swing into action the moment the control switch is set. In such case, energy is being consumed, not much of it, but the necessary modicum to enable the factory to begin performing its appointed work, promptly and with full efficiency, when the starting hour arrives.

AS with the factory so with the body: maintenance of it in form fit for meeting either emergencies or the orderly routine of the day calls for a definite though relatively small expenditure of energy. The measure of this resting energy consumption is the measure of one's *basal metabolism.* This measure provides a baseline, so to speak, from which to determine the overplus of energy required in the performance of particular tasks calling for either physical or mental effort.

Countless studies of warm and cold blooded animals, and of man himself, conducted by Dr. Benedict and his staff, and by other workers in the field of experimental physiology, have led the investigators, slowly, step by step, to recognition that combustion of food by the metabolic processes of the body produces heat; that the heat so produced represents the energy available for work; and that, in the performance

[1] One gram is approximately 1/30 ounce.—*Ed.*
[2] *Mental Effort,* Francis G. Benedict and Cornelia Golay Benedict, being No. 446 of Carnegie Institution publications.

of a given task, the measure of the heat output in excess of that required by the basal metabolism of the body is the measure of the energy expended in such activity.

First steps in the attempt to determine the basal metabolism of the body, the factors affecting it, the heat-energy required in support of it, led Dr. Benedict to the construction of an air-tight and heat-tight chamber so arranged and equipped that a person could live in it under controlled conditions without discomfort for days at a time.

Ingenious devices and methods enabled the observer to record the amount of heat-energy produced by the person inside—when asleep, when resting quietly, after fasting, after eating a hearty meal, when engaged in muscular work of various intensities, when performing difficult mathematical calculations.

Measuring the energy consumed in merely keeping alive. The subject lies in a comfortable position, his head enclosed in an air-tight helmet provided with a window for vision. Although the apparatus differs somewhat from that employed in measuring the energy requirements of strenuous work, the principle upon which it operates is the same. The measure of the heat-energy required when the subject is awake, lying prone, quietly resting before breakfast when the digestive processes are at lowest ebb, is the measure of his basal metabolism

AFTER many observations, it was found that body metabolism is sensitively responsive to conditions and influences. A hearty meal, for example, will increase the heat output as much as 40 percent, and the increase, gradually lessening, may last from 10 to 12 hours. In prolonged fasting, on the other hand, heat production falls off rapidly for a time and then becomes relatively constant at a lower level. Exercise in any form meets a quick response in heat production and so do fluctuations in the state of one's health.

Consideration of all the factors affecting metabolism led to the conclusion that the heat-energy required by the vital processes alone, that is, the measure of the basal metabolism of the body, could best be determined when the subject is awake, lying prone, quietly resting, before breakfast when the digestive processes are at lowest ebb. Taken at such a time and under such conditions, Dr. Benedict is convinced that every healthy person will show a basal metabolism that is remarkably constant for that person. Having determined what the basal metabolism of a given subject is, it is a comparatively easy matter to measure the change made when he is assigned a task requiring special effort, either physical or mental.

Although the essential features of the method of measuring the energy demands of special tasks were developed through employment of the respiration chamber, already mentioned, in consequence of information gained through its use, the chamber was soon superseded by much simpler and less expensive apparatus.

That is to say, it was found that the consumption of oxygen, the production of carbon-dioxide, and the liberation of heat-energy, phenomena which always occur when fuel is burned or food is consumed, are all so closely correlated and occur in such constant ratios that, given one of these factors, the others can be found by simple calculation. In practice, then, all that the investigator needs to obtain is the exhaled air of the subject undergoing test; analysis and measurement of this exhaled air will give the amount of oxygen consumed, the only factor needed to determine the energy expended. Simple and convenient apparatus for collecting the expired breath, suitable for various types of experimentation, have been developed.

Through application of this method of measuring the metabolism of the body many interesting and important facts have been learned.

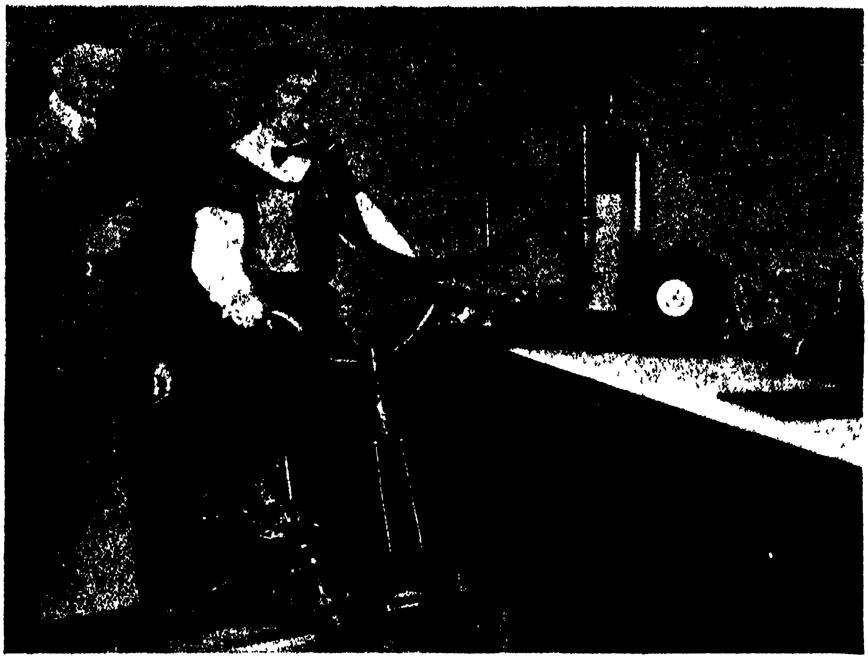
It has been found, for example, that although the basal metabolism of individuals differs, the heat-energy production of the average man in a group of 100, when lying quietly in bed before breakfast, is about one calorie per minute—just about the amount produced in the same length of time by a 75-watt electric light, or a burning paraffin candle of ordinary size. This represents the overhead cost, the cost prior to production, as Dr. Benedict puts it.

He adds: "Two lumps of sugar would run a man resting quietly for about an hour; a pat of butter, for one and one-half hours; and a doughnut would furnish the calories he would need for about three hours. Now, when he begins to move about the costs mount. Just sitting up increases the cost 5 percent, standing up 10 percent, a brisk walk will increase it by 200 percent, and a man working up to the limit of human endurance will increase it 1000 percent or more."

Putting the matter another way, many studies made by Dr. Benedict and his co-workers in this field show that, in general, a person engaged in a sedentary occupation requires 2500 calories per day to cover basal needs and the energy expenditure because of work. Farmers, on the average, consume about 3500 calories a day. Maine lumbermen have been tested whose energy expenditure reached 7000 calories; while Dr. Benedict reports a study made of a professional long distance bicycle racer who developed a metabolism of the rate of 10,000 calories per day.

SUCH energy provisions, it should be said, represent the need of the average member of the respective groups; they must be modified to suit individual requirements. Thus, for example, experiments show that a heavy man expends more heat-energy in support of basal metabolism than a thin man of the same height; that a tall man expends more than a short man of the same weight; that a man of 25 years of age expends more than a man of 70; and, as to sex, even though weight, height, and age are taken into account, a man's basal metabolism will run about 10 percent higher than that of a woman.

If the food intake, in a specific case, is greater in energy-yield than the individual expends in maintaining his basal metabolism and his normal activities, the excess is stored up in his



Respiration apparatus developed by Dr. Francis G. Benedict for measuring the oxygen consumed in strenuous work. The nostrils are closed by a clip and the subject breathes through a rubber mouthpiece. The exhaled air passes through a chemical that absorbs the carbon dioxide. Oxygen from another receptacle is fed into the air stream as needed, to supply the loss through combustion, the amount used in a given time being registered on a gas meter. The oxygen consumption being known, the energy expended in pedaling can be calculated

tissues in the form of fat and he takes on weight. On the other hand, if the food eaten yields fewer calories than the body requires, reserve stores are drawn upon, weight decreases, and energy production diminishes.

Dr. Benedict says that in the great proportion of cases the only reason people grow fat is that each day they eat a little more than they require. To quote from his discussion of this matter: "If you eat the equivalent each day of an ounce of butter *more* than you need what happens? You don't lose it; you don't burn it; it is digested, assimilated, and, note this, it is deposited as fat.

"ONE extra ounce of fat means a pound in about two weeks or 25 pounds a year. All this from but one ounce, say three pats of butter *extra* each day. Please note that I emphasize *extra;* that means three pats of butter *above* your daily needs. This goes on gradually, I might say insidiously, until the weight increases, the girth increases, the creases increase, and there you are.

"The best way of all to lose fat is not to get fat. If you are fat then it is nearly hopeless to attempt to 'work it off.' There is only one way to lose it intelligently, and that is to limit your intake slightly and burn it up slowly. Fats are, so to speak, twice as concentrated as starches and sugars; hence it is helpful if one avoids all visible fats in the food.

"Cutting out visible fats is usually not a great hardship, but of itself it is of no value if one over-eats other equally fat-producing materials. It is useless to cut out any particular article of the diet, such as bread or potatoes or butter, and then fill up on ice cream. Diets of salads and greens are sound in principle but may be easily overdone and produce digestive disturbances. The use of patent preparations to produce slimness is nonsense.

"There is no royal road to slimness. Diet reduction, at times demanding a Spartanlike abstinence from especially loved foods, is the only really logical procedure. It all boils down to a careful, intelligent curtailment of food or fuel intake. It might be termed 'scientific stoking.'"

Since the caloric value of all the commoner food-stuffs has been determined and since information is now available regarding the fuel requirements of persons working in the principal occupations, suitable meals can be provided for individuals which will enable them to do their work well and yet maintain their vigor and sense of physical well-being.

In making such provision, however, it is now clear, due to the recent study of mental effort made by Dr. and Mrs. Benedict, that no special dietary preparation needs to be made for the brain-worker.

In planning this investigation it was decided to study particularly the effects of mental effort upon heart rate, the mechanics of respiration, the carbon-dioxide exhaled, the oxygen absorbed, and the "respiratory quotient," the latter of which gives information as to whether the body is consuming proteins, chiefly, or carbohydrates. Extraneous activity, if any, was to be recorded and the heat production was to be calculated from the measured oxygen consumption.

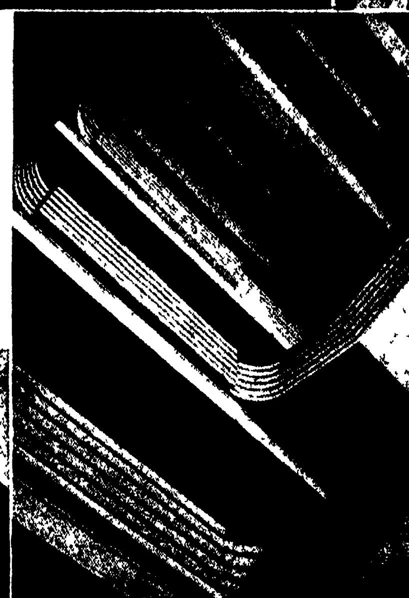
Six men and one woman were selected to serve as subjects. Of the men, five were university trained and two had the rank of college professor. The woman had been a professional accountant. All were in good health and records of their basal metabolism showed that they were physiologically normal in every respect.

The subjects were tested several times when in each of three mental states: awake but in "mental vacuity," that is, thinking of nothing; in a state of "mental attention," but without tension; and during sustained, intense mental effort, as in multiplying two-digit numbers, the entire process being carried out mentally and continued without interruption for an hour.

IN summarizing the conclusions reached, Dr. and Mrs. Benedict say, in part: "From a consideration of the various factors measured in our investigation it is concluded that sustained, intense mental effort causes an increase in heart rate; an insignificant, hardly measurable increase in respiration rate; a marked alteration in the character of the respiration; a considerable increase in the apparent total ventilation of the lungs; a small increase in the carbon-dioxide exhalation; a smaller increase (on the average, 4 percent) in the oxygen consumption and heat production; and a slight increase in the apparent respiratory quotient.

"The small increases in oxygen consumption and heat production are in large part to be accounted for by the increased muscular activity accompanying the increased ventilation of the lungs and the increased heart rate. Hence, making a most conservatively small allowance for the effect of increased circulatory and respiratory activities in this small metabolic increase, we conclude that mental effort *per se* is without significant influence upon the energy metabolism.

"In view of the sense of extreme, almost over-powering fatigue in both mind and body following sustained intellectual activity, it is surprising that brain-work has such an insignificant effect upon the general level of vital activity. This pronounced sense of mental and physical fatigue following mental effort, noted by so many brain-workers, can hardly be explained by the slightly increased physical activity of the heart and respiratory muscles. Our study gives us little, if any, direct evidence for a satisfactory explanation of this feeling of extreme fatigue."



A group of residential buildings on the outskirts of Frankfurt-on-Main, in which the indented arrangement makes it possible for sunlight to enter every room. Although the buildings are uniform in character, touches of individuality are provided by garden and grass plots

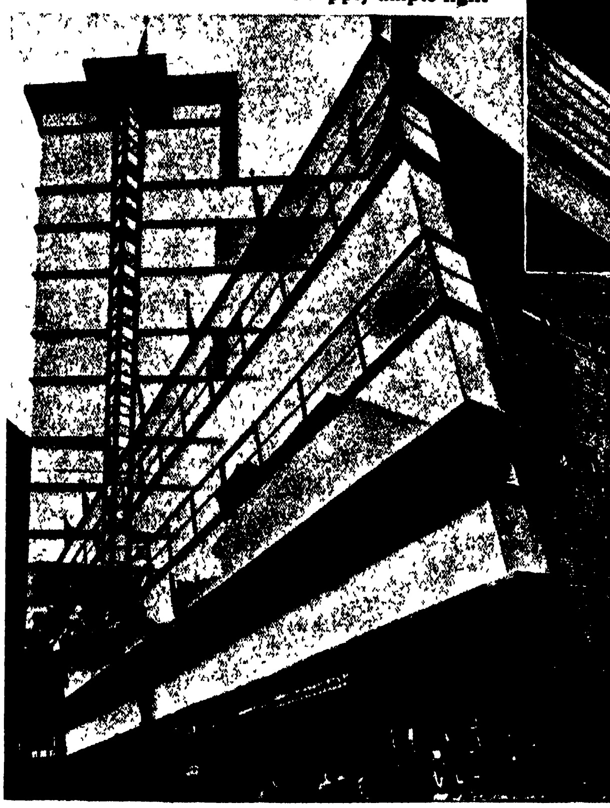
Right: Looking up through the well of a modernistic staircase: Town Hall of Rustringen

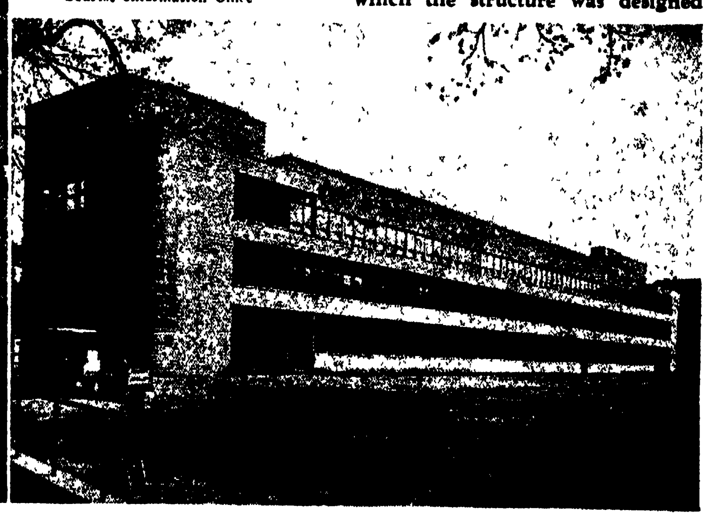
Below: Distortion by the camera lends odd angles to the walls of this modern retail store in which continuous windows supply ample light

Above: A staircase tower entirely constructed of reinforced concrete and glass, so that the spiral stairway receives a maximum of light

Below: The Labor Exchange in Kiel, in which long undivided offices extend the entire length of the building, an arrangement which is admirably suited to the purpose for which the structure was designed

Photographs courtesy German Tourist Information Office



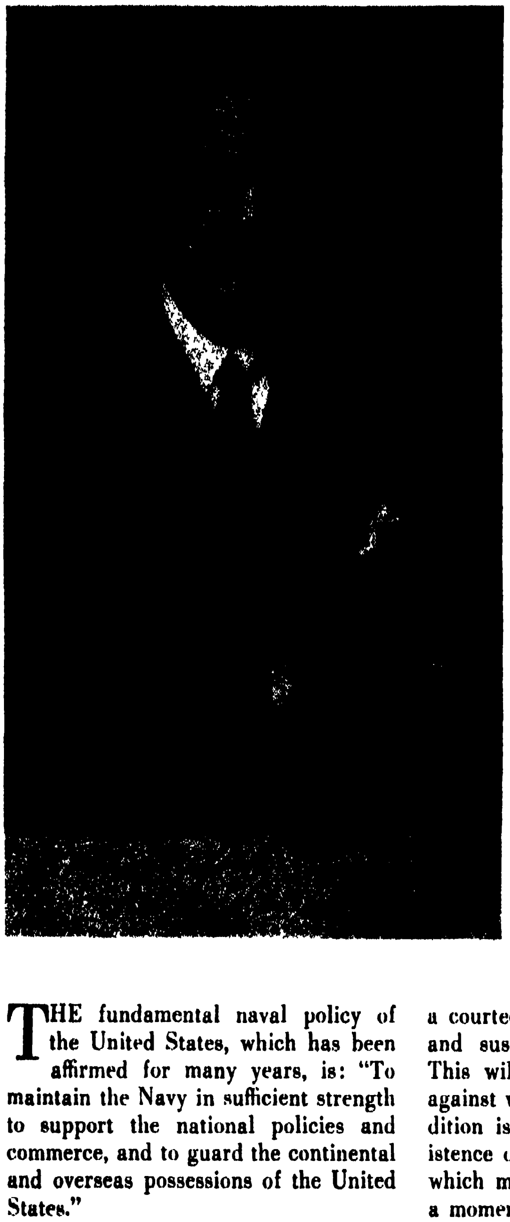


Modern Architecture in Germany

THE history of a thousand years of architecture may be read in the walls of buildings throughout Germany; but, on the other hand, a modern trend toward designs demanded by special purposes will be found side by side with the old. This newer architecture, examples of which are shown in the above group, is rapidly growing in favor, not only because of the individualistic expression which may be obtained by means of it, but also because of its adaptability to purposes of business and industry. Great stress is being placed by architects on the fact that the purpose of new buildings and their internal arrangement should be honestly and clearly indicated by their façades. Although this objective fitness is the keynote of construction, the personal expression of artistry is not precluded, and great factories and halls that have been erected not only symbolize their purpose but also appeal to the eye and stimulate the sense of appreciation.

Why the New Naval Building Program

By HENRY L. ROOSEVELT
Assistant Secretary of the Navy



THE fundamental naval policy of the United States, which has been affirmed for many years, is: "To maintain the Navy in sufficient strength to support the national policies and commerce, and to guard the continental and overseas possessions of the United States."

The obligation laid upon the Navy by the enunciation of this policy is a grave one, far reaching in scope, and presenting many difficulties. The Canal Zone, the insular possessions, and Alaska combine to present a problem very different from one involving only coast defense.

The United States is a signatory to international treaties which establish the naval strength of the several great powers, not only as to total naval tonnage, but as to the numbers, size, and armament of the several categories of ships.

This definitely fixes the size of our Navy and precludes the old discussion of what is an adequate Navy. There can be no question of naval races for supremacy. The ratio is established and each country that is a party to the naval treaties has but one obligation and that is to keep naval building programs within treaty limits.

My position on the question of national defense is quite clear. I am for a Navy second to none: A Navy built to the limit of our treaty commitments; and a definite national policy of continued building that authorizes the President to construct such vessels as may be necessary to replace obsolete vessels in order to maintain the Navy at treaty strength, and thereby to evolve a logical, orderly plan for the maintenance of the Navy that will also promote efficiency and keep expenditures at a minimum.

For our national security it is not sufficient to have the will to enforce a principle which is firmly held and avowed. There must be a clear expression of national purpose accompanied by evident and sufficient means to carry it into effect, provided the policy is maintained with a courteous consideration of the rights and susceptibilities of other nations. This will afford the surest safeguard against war. On the other hand, no condition is more hazardous than the existence of the dormant popular feeling which may be fanned to fever heat by a moment of great passion and behind which lies no organized power for action.

IT is necessary for the protection and security of our national ideals, commerce, and continued pursuit of peaceful occupations, for this nation to have international police protection in the form of a protective navy. In my opinion a navy is the very cheapest national insurance that can be procured but it must be adequate to give full protection. A famous Admiral has very aptly remarked, "A second best Navy is like a second best poker hand—worthless when called."

It is, therefore, most essential that this country build its Navy up to full treaty strength and maintain it in a most efficient manner. This is believed to be the very surest preventive measure to avert trouble as long as we pursue a policy of non-aggression and so long as we remain a peaceful nation. Only a few days ago the President reiterated our resolve never to seek another yard of territory by conquest, and we have renounced war as an instrument of national policy. What nation on earth will be enticed to attack a nation with a Navy second to none, ready for any emergency, and backed by our national resources?

ON the other hand, an unprotected nation with our far-flung commerce, distant possessions, and wealth may easily attract an avaricious and greedy enemy to attack and make war on any slight pretext. Then consider the cost in human life and wealth to rise and resist the invader.

In our own enlightened land if it is considered necessary to maintain an effective police force it would seem to me that the international situation reveals nothing of so encouraging a nature as sufficiently to justify our not having a Navy.

Our danger is that we sometimes fail to have a comprehensive idea of our needs until it is too late. In that case the expense in both lives and property is tremendous and many times greater than the insurance cost would have been had foresight and vision been exercised.

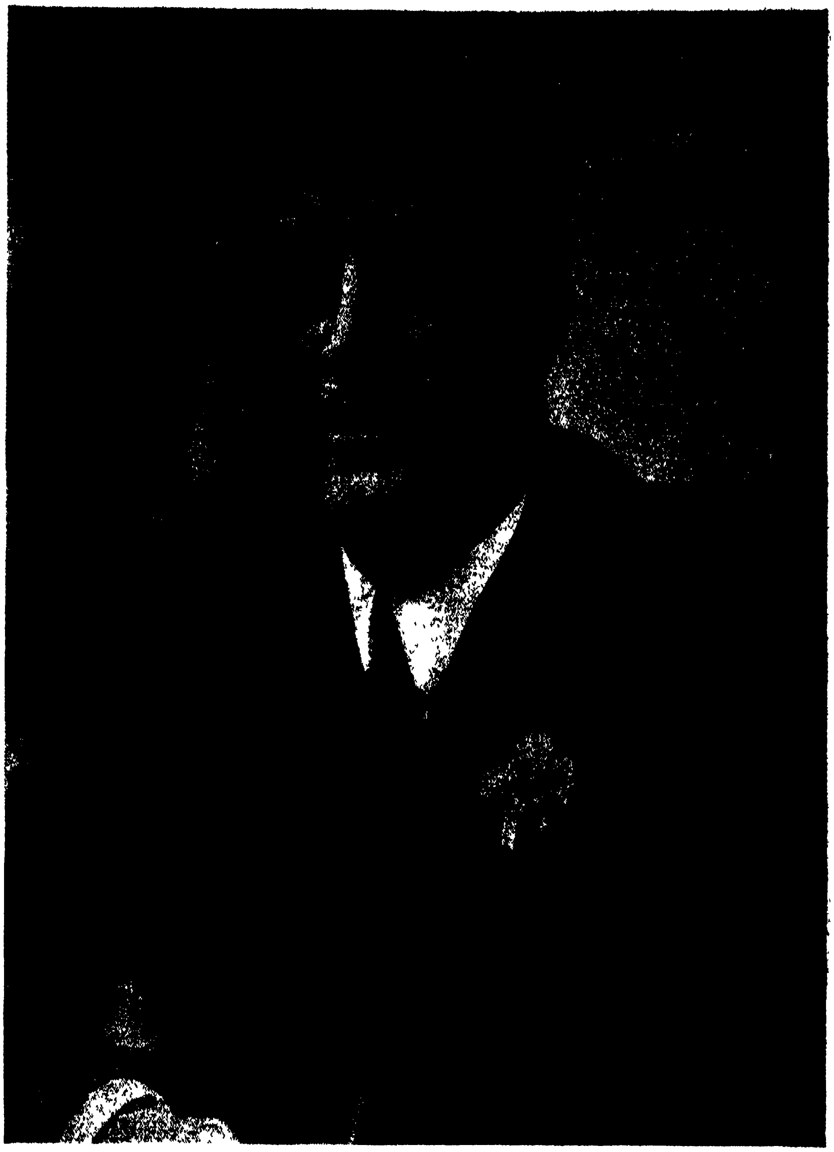
The mission of our Navy is to keep open our lines of communication and to protect our country from attack by an enemy. Our trade extends to every quarter of the globe. It is the very life blood of our industrial and agricultural prosperity. It is necessary that the sea lanes be kept open when other nations are at war. Our neutral rights must be respected by belligerents. The ocean roads to our own possessions in the West Indies, our immense coast lines on both the Atlantic and the Pacific, the Canal Zone, as well as our trade routes to all the markets of the world, these are as much integral parts of our transportation system as the great railroads that span our continent. Over these lines that traverse every ocean and enter every port, are carried the exports and imports which turn the wheels of our factories and supply the necessities for our national well-being.

In the protection of our own coasts there is a general misconception as to the strategy involved. With fast light forces

IS NECESSARY

and aircraft engaged in modern warfare it becomes necessary to advance the first line of defense far seaward. This is to cut off raiders and commerce destroyers and to prevent aircraft carriers from coming in close enough to launch air attacks on our coasts, and though our policy is purely defensive, since we have vast interests beyond the seas, it follows that the Navy can not be limited purely to coast defense. And it must be added as a military axiom that war, however defensive in moral character, must be waged aggressively if it is to be brought to a successful conclusion.

From the standpoint of those who are responsible for the readiness of the Navy to meet the demands of national defense it is extremely necessary that the future composition of the fleet be known as far in advance as possible so that personnel training and strategic and tactical plans for probable contingencies may be made on some definite basis.



President Franklin D. Roosevelt was Assistant Secretary of the Navy during the World War when the unpreparedness of our Navy made it necessary to inaugurate an inefficiently speedy naval building program. He has shown himself sympathetic to the needs of the Navy since his inauguration as President

PRESIDENT ROOSEVELT in the early part of his administration wisely decided to add to our sea strength and authorized the expenditure of 238,000,000 dollars from the Public Works Program for the construction of naval vessels. This work was started promptly and has done much to revive the American shipbuilding industry, as the new construction was allocated to both government and private yards on both coasts.

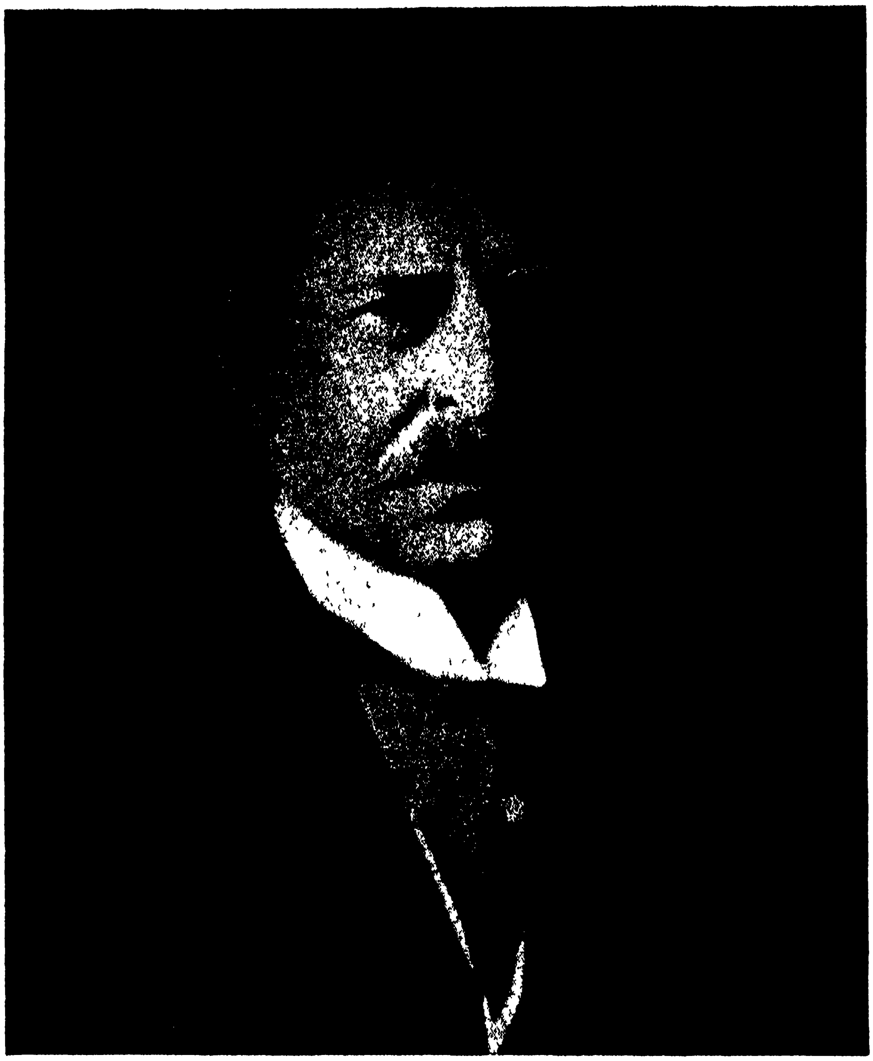
The new building program is a step in the right direction and we are at last upon the road to the realization of a Navy built to treaty strength.

The primary purpose of building men-of-war is to provide means for protecting our interests and for supporting our policies. In addition to this, however, the effect of shipbuilding as a stimulus to industry can not be overemphasized. In the first place employment is provided for many thousands of skilled artisans whose special training and abilities are essential to our continuance as a sea-faring nation. In the second place, the building of a ship is a truly national undertaking, in which every state of the Union contributes a share. Steel, lumber, paint, machinery, electrical equipment, metal fittings, furniture, and so on, come from widely separated sources and in great quantities. The assembly and transportation of these materials provide occupation for additional thousands with the accompanying circulation of wealth which recently has been so badly out of adjustment. Then, when she is completed, each ship will require fuel, food, ammunition, and other supplies of many kinds. Almost all of these come from domestic sources even when the fleet is cruising in foreign waters.

By having an orderly program of replacement, our ship yards will carry a constant load and give steady employment. Our ships will be cheaper and vastly better. They will be better designed and better built. More opportunity will be given for general improvement in machinery and equipment. There will be a steady improvement in the building of each vessel and ships will become over-age in normal numbers and not by large groups at the same time.

A fleet is like the fire department of a large city. It must be organized and equipped to meet any conflagration on instant notice. It must be of the necessary strength to cope with the existing emergency. It can never afford to come out second best in any major encounter. A good fight in the sporting world may be acclaimed; but with the destiny of a nation at stake the only type of a navy to have is one in which we have assurance that it will be successful in repelling any hostile attack on our shores, or, in case of war between other nations, will compel respect for our neutrality and the non-interruption of our seaborne commerce which is so vital to our prosperity and national wealth.

The fleet is our first and most important line of defense. The fleet must be ready every day for a national emergency and for that fleet to be deficient in either strength or training is to court disaster. The expenditures already made will not only be lost but irreparable damage may follow. Replacements in a navy take time; two to three years are required to build a ship and the same length of time is necessary to develop a trained crew to fight her effi-



I believe one of the strongest guarantees for peace and justice is an adequate United States Navy - a treaty Navy second to none.

Claude A Swanson
SECRETARY OF THE NAVY.

ciently. It is apparent, therefore, that when an emergency does come we must rely upon our effective units ready at the moment to provide the insurance against catastrophe.

The naval treaties of the past 14 years have tended to cut down the size and number of ships allocated to the several great powers but they have put a premium on naval efficiency. With a limited number of ships, superiority can be attained only by excellence of performance. As a consequence, more than ever the training, morale, and intelligence of the naval personnel must be stressed and safeguarded.

IN our enthusiasm for material let us not overlook the necessity for an adequate and contented naval personnel to man and fight those ships efficiently should the occasion demand. The training of men requires time and experience. Men-of-war with undermanned crews on board are inefficient for a campaign. It is dangerous to allow the personnel of the active fleet to fall below proper complement, and reduction in personnel allows no reserve to call on for the rapid expansion necessary in time of an emergency. To do so is to flirt with fate and is poor economy.

In building a navy care must be exercised that the balance is maintained between the types of vessels. The fleet not only must have capital ships, heavy and light cruisers, plane carriers, destroyers, submarines, mine planters and mine sweepers, but must have an adequate naval air force, equipped and trained for the special type of air work required by the Navy. It must be remembered that naval aviation has problems that present great difficulties and complexities. The strides made by the Naval Air Force are most encouraging

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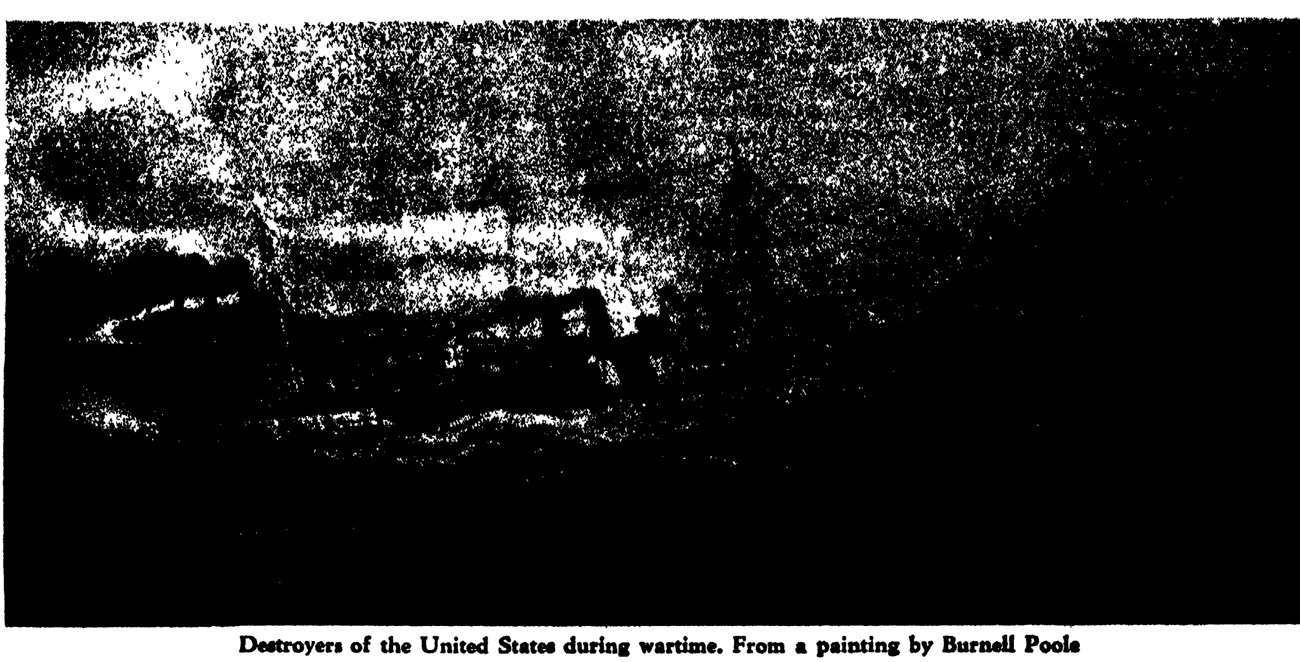


Destroyers of the United States during wartime. From a painting by Burnell Poole

THE AMATEUR AND HIS MICROSCOPE—X

MOUNTING SPECIMENS

By JOHN F. BRANDT
Bausch & Lomb Optical Co.

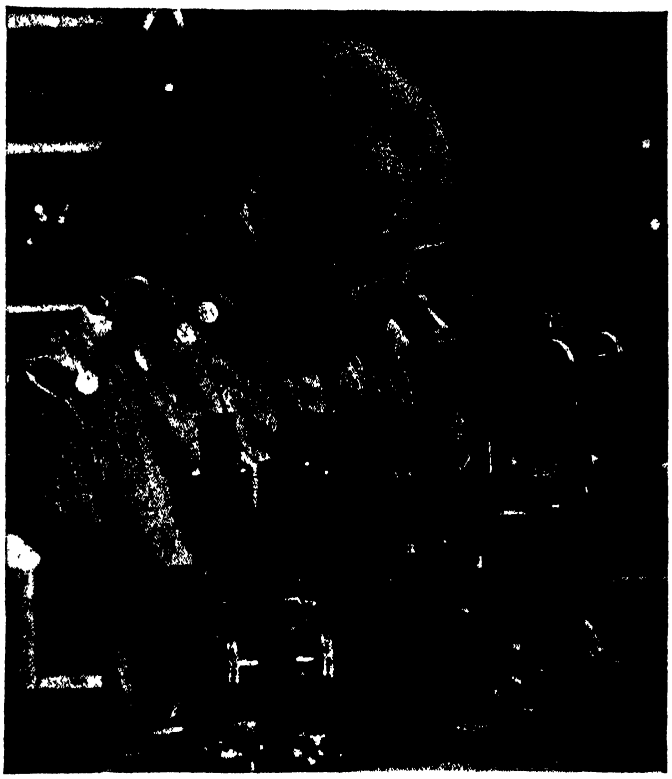
IT may be well for us to pause in our exploration of the microscopic world to learn the fundamentals of permanently mounting the more interesting specimens which we discover, and so start our slide collection. The subject of mounting different types of specimens, with all the different techniques and reagents which are involved, is too broad to be covered in this article. What can be done, however, is to cover the general method and define the terms, thereby giving you a basis upon which to work when you go to the more technically worded reference books on the subject. An excellent book for the beginner is "Animal Micrology" by Michael F. Guyer. Two reference works which cover the subject quite thoroughly and should be in every microscopist's library are McClung's "Microscopic Technique" and Lee's "Microtomist's Vade-Mecum."

THE mount usually consists of a slide—3 inches by 1 inch is the standard size—upon which the specimen is affixed in a mounting medium with a cover glass over it. On the upper surface, and at the left-hand side of the slide after it is placed in the microscope for properly viewing the specimen, is a small square label giving the maker's name, and data concerning the specimen (see illustration). Notice that the word "usually" is used. Often such comparatively large specimens as crystals and minerals are mounted in pill boxes, but since this requires no technique we shall not need to consider it here.

The general plan in mounting a whole biological object is as follows: (1) Killing and fixing, (2) washing, (3) staining, (4) decolorizing, if necessary, (5) dehydrating, (6) clearing, and (7) mounting. Comparatively few objects can be mounted whole; they must be sliced to translucent thinness, or "sectioned." In the case of some specimens, such as plant stems, sectioning consists of nothing more than slicing it with the razor. However, with others, such as earthworms, this method would seriously distort the cell structure and give us an untrue image. We therefore mount the specimen either in paraffin or celloidin, which permeates the structure and holds it stiff while it is being cut.

The first four steps of either the paraffin or celloidin method are the same: (1) killing and fixing, (2) washing, (3) hardening and dehydrating, and (4) absolute alcohol. For the paraffin method the added steps are: (5) de-alcoholization (xylol), (6) melted paraffin, (7) embedding, (8) sectioning, (9) affixing section, (10) removal of paraffin, (11) through alcohols to stain, (12) staining, (13) washing, (14) dehydrating (after decolorizing, if necessary), (15) absolute alcohol, (16) clearing, and (17) mounting. For the celloidin method the corresponding steps are: (5) ether-alcohol, (6) thin celloidin, (7) thick celloidin, (8) embedding, (9) sectioning, (10) staining, (11) washing (and decolorizing, if necessary), (12) dehydrating to 95 percent alcohol, (13) clearing, and (14) mounting. It is suggested that the reader put the above in the form of a chart in his notebook, so that he will have it for ready reference when needed.

Just reading over the steps necessary to mount a specimen is enough to make one throw up one's hands in despair of ever mastering such a complicated technique. But it is really not quite so hard as it looks. The thing to do, of course, is to start with some specimen which is quite easy, and gradually progress to the more difficult ones. Do not try to learn the method by heart; just follow directions in making up one mount and thereafter you will discover that you can rattle off the necessary basic steps without any effort.

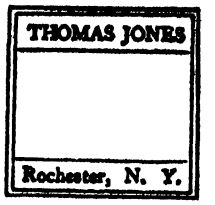


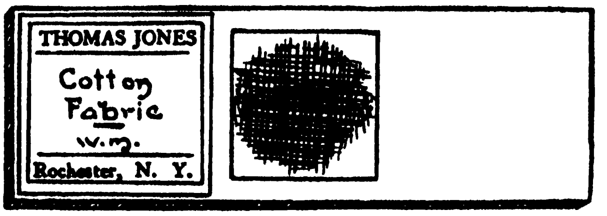
Using one of the finest and newest research microscopes

KILLING, fixing, and hardening are often done with the same reagent. The purpose is to destroy the life in the tissues in such a manner that they will retain as nearly as possible the same form as they had when alive. This can be done by instantaneously killing and fixing, or by first anesthetizing and then killing. The purpose of fixation is also to make such changes in the organisms that later staining or other chemical treatment will bring out certain characteristics or parts of the structure.

The fixing agent is now washed out either with water, as is usually the case, or with alcohol if certain fixing reagents are used. After that it is necessary to dehydrate the specimen at once by passing it through a series of alcohol solutions of different strengths until it reaches a solution of from 70 to 95 percent alcohol, depending upon the clearing agent to be used. The alcohol referred to is regular grain alcohol, though denatured alcohol may be used on occasions. It must be remembered that denatured alcohol, besides being only 70 percent, also leaves some sediment on evaporation. Grain alcohol, as

regularly sold, is from 95 to 96 percent. The sections are brought up through a graded series of ever stronger alcohols, to avoid the distorting effects of sudden dehydration. The alcohol is diluted with distilled water obtainable from a garage. Solutions of 50, 70, 85, and 95 percent are most generally used. These alcohols, when used, are not necessarily useless thereafter. When you have finished with them, they may be poured into *separate* containers labeled "Used 50 Percent Alcohol", and so on. The used alcohols naturally contain more water, since they dehydrated the specimen, but the amount of water absorbed from one specimen is not enough to do any harm.



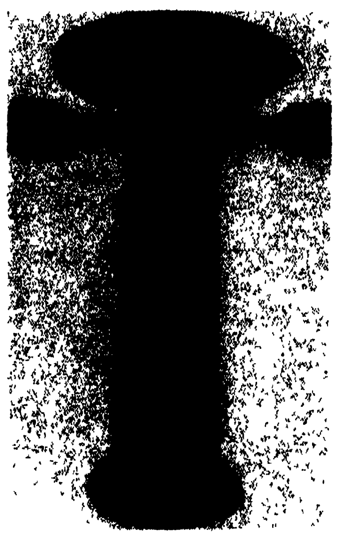


Above: **A typical finished microscope slide with label and,** ***at top,*** **the same label before filling out**

We now de-alcoholize and clear the specimen. Both operations are usually done by the same agent, and the purpose is to remove the alcohol to make way either for the embedding material or the mounting medium, and to make the specimen more transparent to light. Xylol may be used as a clearing agent; so may carbolic acid dissolved in absolute alcohol. (Absolute alcohol is made by adding a little calcium chloride to 95 percent alcohol. This settles to the bottom and does no harm, but absorbs the 5 percent of water.) Very often, however, one of the essential oils is used, such as cedar oil and analin oil. The general characteristics of a clearing agent are that it must be able to remove the alcohol from the tissues, must have a slightly higher refractive index than the tissues into which it is to penetrate, and must be miscible with the imbedding material or the mounting medium as the case may be.

THE de-alcoholization and clearing completed, we proceed to mount the specimen on the glass slide. Practically all specimens are mounted in Canada balsam dissolved in xylol, but this is not a necessity. Some specimens are mounted in glycerin or glycerin-jelly, and there are other mediums much the same as balsam, such as gum damar, hyrax, or euparal dissolved in either xylol, turpentine, or benzol. The amateur need not concern himself for quite some time with any but the Canada balsam dissolved in xylol; that is, the usual commercial liquid balsam.

It is not always possible or desirable to mount the whole specimen. Sometimes we wish a cross-section. To do this we infilter the specimen with either paraffin or celloidin (these are the most common methods, though freezing and sometimes the use of other substances are resorted to) so that it will be stiff enough to cut without distortion. In general, the specimen is taken from the absolute alcohol and immersed in a mixture of one-half alcohol and one-half xylol. It is then immersed in plain xylol. Then it is removed and immersed in a mixture of one-half xylol plus one-half melted paraffin, and next into melted paraffin for a varying amount of time according to its size. Then it is transferred to a small mold of more paraffin. When the paraffin has hardened the specimen in the paraffin is taken out and the whole thing is sliced either free-hand with a very sharp razor, or with the aid of a Well microtome or automatic microtome (see illustrations). The sections are then affixed to the slide, the paraffin is dissolved by xylol, and mounted in the usual way. The celloidin method is much the same, as can be seen from the general plan given above.



The Well microtome. The object is placed in the central part and is moved up by a micrometer screw, then sliced off with a razor

The purpose of staining, as was explained in the article, "Examining Milk for Bacteria" (March, 1934), is to bring out certain features of the specimen which we desire to study, or to heighten contrasts within the specimen. Sometimes only one color is used and at others two, three, or four, the further to increase the contrasts. Explanation of the staining has been left to the last because just where we make use of it in the process of mounting depends upon whether the stain is in aqueous solution or alcoholic solution. A stain in aqueous solution should follow the washing, and a stain in alcohol solution should follow dehydration—or whatever point in the dehydrating procedure the percent solution of alcohol equals the percent solution of alcohol in the stain. Some stains are dissolved in 70 percent alcohol, while others are in 95 percent alcohol. Stains can be used over and over again, almost indefinitely.

THERE you have the general groundwork for an understanding of the various methods of mounting specimens. Though it has been given as briefly as possible it may seem complicated, since methods of procedure and exact details have been omitted. These are given in the books named near the beginning of the present article. But we learn by doing, so let us take some simple specimen and mount it as the first step in forming our slide collection.

An automatic microtome (the new Minot rotary type). Such microtomes are equipped with automatic feeding mechanism and the worker makes his sections simply by turning the crank. They are essentially highly refined and glorified automatic ham slicers, but the slices taken can be made as thin as one 12,000th of an inch

THE following instructions were prepared by Julian D. Corrington, Ph.D., of Ward's Natural Science Establishment, Rochester, N. Y. Readers will recall that Dr. Corrington was the author of the article entitled "Exploring Unknown Waters," in the November and December numbers of this magazine. He writes:

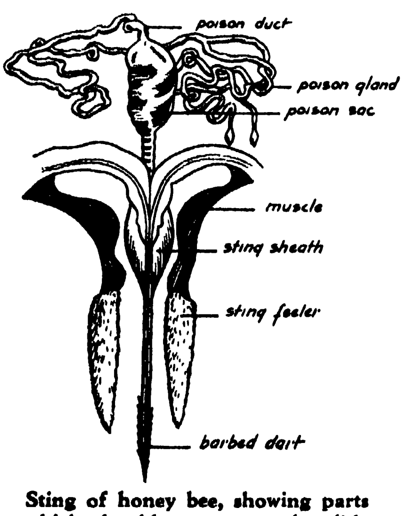
KILL a worker honey bee with cyanide, or by crushing or cutting off the head with scissors.

Allow to soak in water for 24 hours. Then place in a Syracuse watch glass of fresh water.

With forefinger of left hand press gently upon the abdomen of the bee, at the same time pulling cautiously upon the sting by grasping it with a forceps held in the right hand. Usually the entire stinging apparatus is expelled intact by this method. Even experts ruin an occasional specimen, so it will be best to have several soaked bees available.

Examine with hand lens, as the sting and its parts float in water, to see that all parts are present. Refer to the illustration. If these parts are not all present. or if any are torn or otherwise imperfect, try again with another specimen.

If the sting is complete, draw off the water with a pipette and replace it with 10 percent formalin. This is the fixer. Prepare by adding ten parts of tap water to one part of commercial (full-strength) formalin. Allow to act for one-half to one hour. Each chemical throughout this technique is to be drawn off with a pipette, to be replaced with some other solution. Do not at any time allow the sting to become dry. It is best, if possible, to prick the poison sac with a needle, to insure penetration of the reagents.



Sting of honey bee, showing parts which should appear on the slide

Rinse the specimen and wash out the fixer by several (two or three) changes of tap water; five minutes each.


An old woodcut of what an early micrographer believed he saw in a drop of water. Note especially the (rotifer?) at 12, with the complete face of a man

Stain for five minutes with a 1 percent aqueous solution of either eosin or light green. Examine. If the stain is too weak, allow to act a longer time. Stains should not be too intense.

Wash in water, to remove excess stain and to check the action of staining.

Successively pass through 50, 70, 85, and 95 percent alcohols; 10 minutes each.

Examine. If the stain is too intense, apply acid alcohol (one percent of hydrochloric acid in 95 percent alcohol) for one minute, washing in fresh 95 percent alcohol to check the destaining. If not sufficiently decolorized, allow the destain to act for a longer time. The destain acts rapidly and may easily remove all of the color; if it does you must restain.

Apply absolute alcohol, 10 minutes. If not available, use carbolxylol (melted carbolic acid crystals, one part; xylol, two parts); likewise for 10 minutes.

Xylol (xylene), 10 minutes, or until the material is translucent (clear).

Transfer specimen to the center of a clean slide. This is best accomplished by using a small strip of cardboard as a lifter. Get under the floating material with the cardboard strip and lift up, depositing material on the slide, together with a few drops of xylol. A camel's hair brush or section lifter may also be used. Avoid forceps or other implements that might tear the delicate tissues.

With xylol to float the material, carefully orient it under the lowest power of your microscope. With needles, shift the parts around so that they are properly spread out for study. Avoid overlapping parts. Have the sting vertical to the observer.

Blot off excess xylol with filter or blotting paper, or slowly and carefully tilt the slide so that the xylol is drained off without disturbing the position of the specimen.

Add two drops of medium-thick balsam and apply cover glass. It is frequently advisable to place several fragments of a broken cover glass around the specimen, to act as cover glass props, preventing crushing of the material. Add the balsam carefully, so as not to disturb the position of parts. Place the slide away in a flat position for at least a week, to dry thoroughly. Then clean and label.

How Not to Swim Faster

By PETER V. KARPOVICH, M.D., M.P.E.
Professor of Physiology
Springfield College, Springfield, Massachusetts

THE author of the accompanying article tells how the science of physics has contributed definite knowledge to the sport of swimming. Swimmers have been experimented on just the same as ship models towed in towing tanks, to determine their water resistance. Athletes long since ceased to smile at such studies, for they are known to have caused too many records to be pushed up. One of the "secrets" of the longstanding successes of the famous crew coach Courtney at Cornell was the fact that he quietly called in some professors at the college of engineering at the same institution and caused technical studies of the dynamics of the rowing stroke to be made. These studies altered various ancient and honored preconceptions regarding the stroke, and helped bring Cornell regatta victories year after year.—*The Editor.*

AN airplane cannot fly without air, yet at a high rate of speed the resistance caused by the air becomes so great that a further increase of speed is almost impossible. To avoid rapidly mounting resistance, aviators attempt to fly in the stratosphere where the more rarefied air offers less resistance.

In the ship- and boat-building industry, engineers have tried to reduce the resistance of water by building vessels with streamlines, in imitation of the body of a fish. This, of course, has achieved its purpose, but when the necessary speed becomes excessively high—for example, in the case of a speedboat—even streamlines became inadequate. Modern speed boats are built somewhat like surf boards, so that when the speed becomes high enough the boat will leave the water and will merely glide on the surface, thus reducing the resistance considerably.

The relation between the displacement of a boat and its shape and speed on the one hand, and water resistance on the other, is well known. About 60 years ago, W. Froude built the first experimental tank where models of ships could be towed at various speeds and the resistance automatically recorded. This was a great boon to shipbuilders. Now they could build a model of a proposed ship, experiment with it, find all the faults in its construction, correct these faults, and then proceed with the building of the real ship. This eliminated guesswork to a great extent and reduced the risk involved.

The problem of water resistance in swimming becomes apparent only with the increase of speed. In every attempt to increase the speed of the movement a paradoxical situation is created: the medium which makes the motion itself possible becomes the main obstacle which limits the speed of movement. Water resistance was also responsible for the invention of the modern swimming strokes. A man who wishes merely to remain on the surface of the water can make any movement with his legs and arms, provided that the direction of the pull is not upward. A man who wishes to swim forward should remember only one rule—to pull backward. But if a man wishes to swim fast and break the existing records, then all his movements should be studied critically and those that increase resistance should be eliminated if possible. In the breast stroke, for example, as the writer has previously shown in this magazine (March, 1930), the recovery position of the legs and arms has a great effect on the speed of swimming. In this position the arms and legs are drawn close to the body and retard the progress so much that the speed may drop from four and a half feet per second to one foot per second within a single swimming cycle. This can be readily observed on any breast stroker. The English overarm side-stroke represents a step forward because at least one arm is taken out during recovery. The crawl stroke is the most efficient stroke thus far discovered, because both arms recover outside the water and do not retard the motion.

The experimental studies of water resistance in swimming were started in 1905 by R. DuBois-Reymond of Germany, who towed swimmers behind a row boat and measured the resistance by a spring scale attached to the tow rope. In 1919, G. Liljestrand and N. Stenstrom of Sweden towed swimmers by means of a windlass, which stood on the shore. In this experiment the towing rope ran over a pulley attached to a spring scale, which recorded the ten-

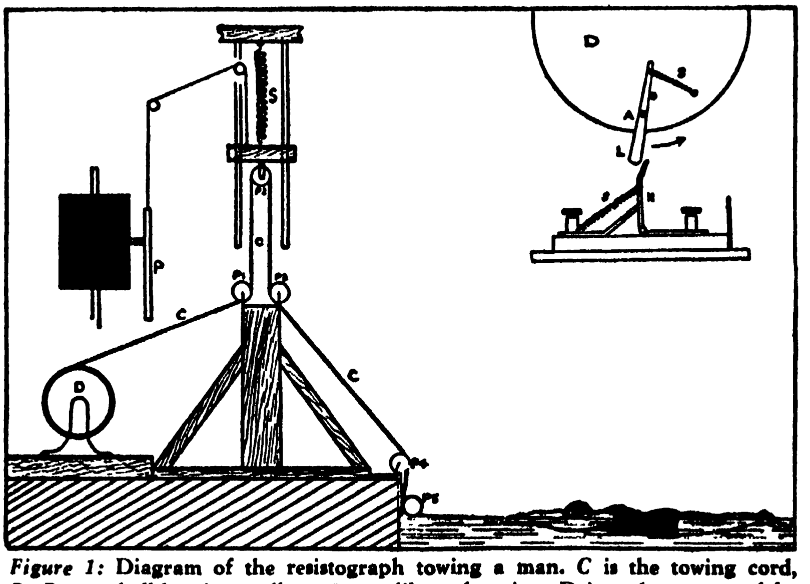


***Figure 1:* Diagram of the resistograph towing a man. *C* is the towing cord, *P1-P3* are ball-bearing pulleys, *S* a calibrated spring. D is a drum rotated by an electric motor. Each revolution of the drum is equivalent to a distance of two feet covered by the swimmer. In the upper right-hand corner is a switch for recording revolutions of the drum. *L* is a lever rotating around *A*; *H*, hinge making contact. In operation, *L* breaks the contact at the switch shown, interrupting an electric current. From *The Research Quarterly*, Ann Arbor, Mich.**

sion on the rope. Recently the writer completed his research on resistance, in which not only men but also women were tested. In this study the swimmers were towed in a 60-foot swimming pool. The speed of towing and the resistance of the water were automatically recorded on a smoked paper by means of a specially devised apparatus called the "resistograph." Figure 1 represents the resistograph, and Figure 2 a sample of the record. Every person was tested from 60 to 200 times.

After the last Olympic games, where the Japanese were so victorious, the findings of this study took on a greater interest because some of the typical Japanese swimmers had been tested. Incidentally the assistant coach of the Japanese Olympic swimming team, Mr. Yanagitta, was also tested by the writer.

BEFORE discussing the results obtained, let us briefly consider the main factors responsible for water resistance. The total water resistance consists of:

1. Wave-making resistance.
2. Eddy resistance.
3. Skin friction.

The first of these factors is due to the waves produced in swimming—the faster the movement the greater the waves. The eddy resistance is due to the physical discontinuity of the streamlines. Take for example the breast stroke. When the person is gliding with the legs and arms extended straight, his streamlines are at their best, but when the same person assumes the position of recovery, the lines become distorted or discontinued. In this case water cannot follow the streamlines and backwash will be produced behind the flexed limbs. Everybody knows that one can ride a bicycle faster when following closely behind a motorcycle with a large windshield. The eddies created by the windshield produce an actual suction effect upon the cyclist behind.

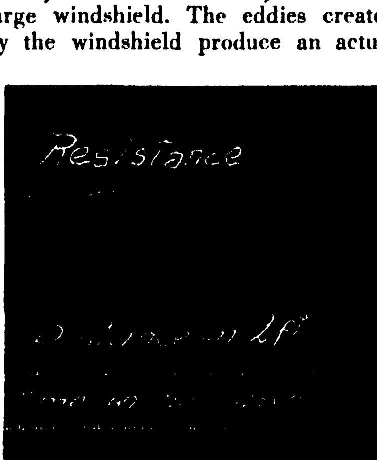


Figure 2: **The upper line represents water resistance. Marks on the middle line represent revolutions of the drum around which the towing rope is wound, each equal to two feet. The lower line is marked in time intervals of 1/20 of a second**

The third factor, skin friction, represents the major resistance factor in the glide. Its degree depends on the dimensions of the wetted area and the smoothness of the surface.

The study of each of these factors separately involves extreme technical difficulty and therefore only the total resistance has been tested.

It has been found that the total resistance depends of course on the size of the person; for example, the resistance for the Japanese swimmers being the same as that for medium-sized American girls. The position of the body in the water is another important factor. Some smaller men in the tests had a greater resistance than the larger men because they could not assume a good flat position in the water.

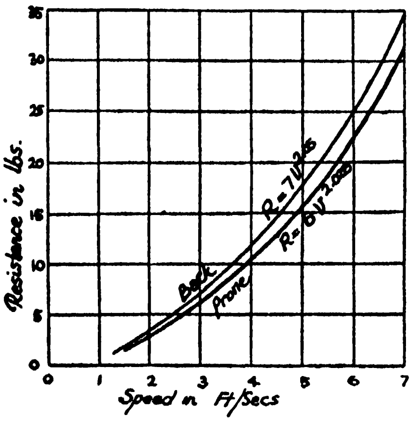


Figure 3: **Curves showing water resistance for Subject S. See text**

The general formulas for water resistance may be expressed as follows:—

Skin surface area in square feet	Resistance in water in pounds (V velocity in feet per second) Prone Glide	Glide on back
Men 24 19	65V²*	75V²
Men and women 19—16 5	55V²	6V²

From these formulas we can see that water resistance increases in proportion to the square of the speed. Figure 3 shows the relation between the speed of swimming and the water resistance. It can be seen that in this case the resistance increased at a rate even greater than the square of the speed. When Subject S was making two feet per second the resistance was 2¾ pounds. At the speed of four feet per second it became 11 pounds. If he attempted to swim, let us say, seven feet per second, his resistance would reach 31 pounds. Additional experiments showed that this subject could develop only 27 pounds of maximum propelling force; therefore he could not possibly attain a speed of seven feet per second—unless, of course, he decreased his resistance or by superior effort attained a greater propelling force.

Experiments showed that if a small man uses a poor technique—if his body rotates too much—the resistance will increase a great deal more than the square of the speed and will be out of proportion to the size of the body. The attempt on the part of swimmers to reduce resistance has led to the "discovery" of a hydroplaning position of the body, with shoulders and head riding high in the water. Although the arguments in favor of this position (by analogy with the speed boat) sound logical, the experiments prove that this position of the body *increases* the resistance, as Figure 4 clearly shows. The mere lifting of the head out of the water tends to increase the swimmer's resistance.

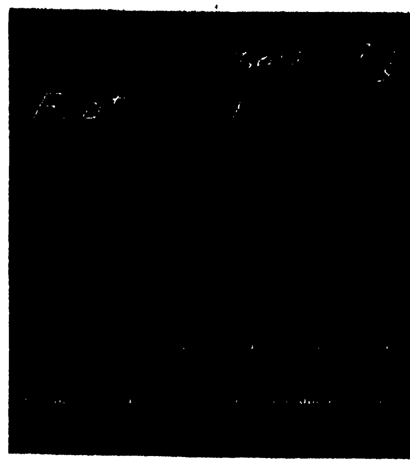


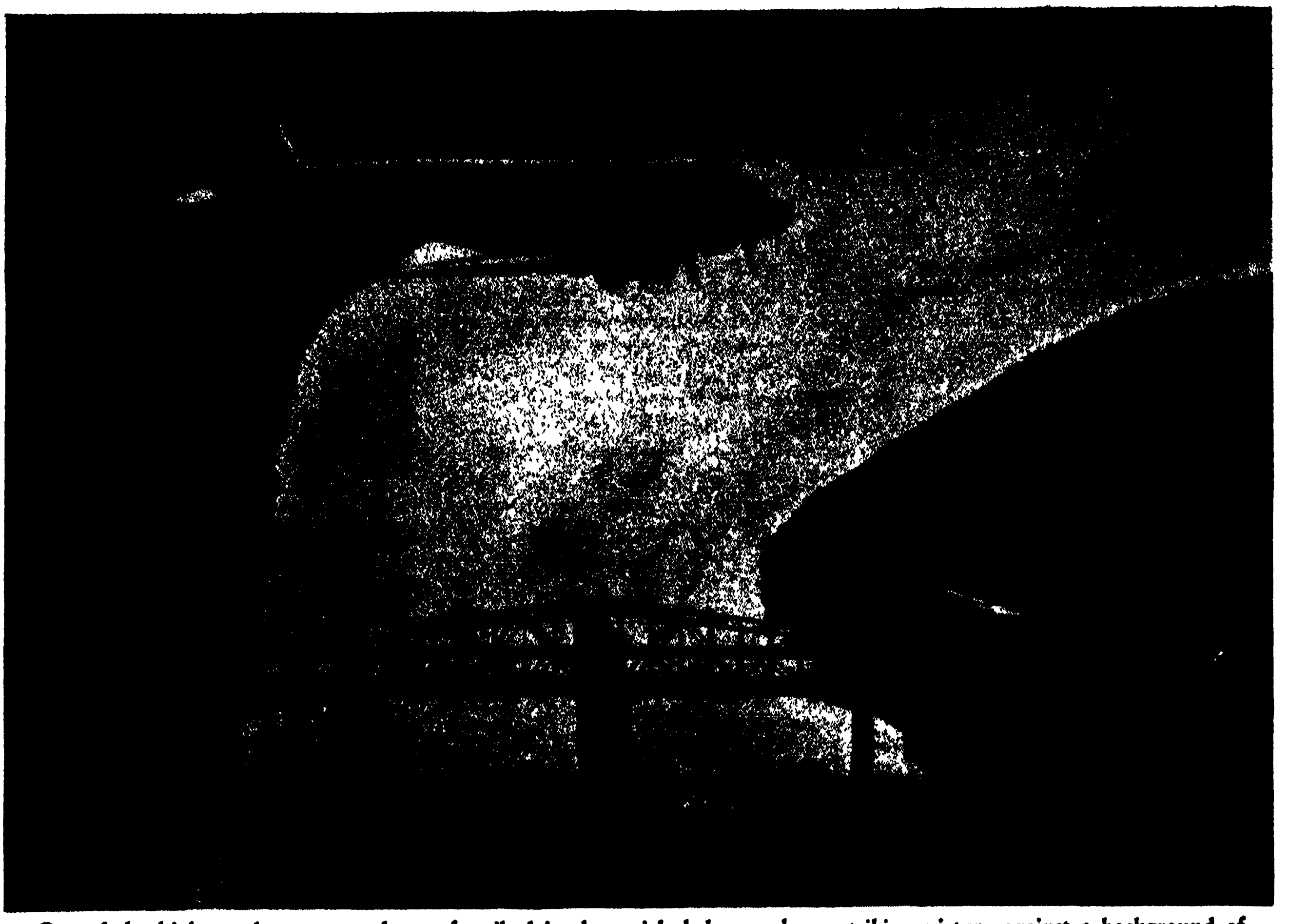
Figure 4: **The hydroplaning argument, like the swimmer, was "wet". Theory favored it but experiment showed just the reverse was true**

NEXT, it is to be noted that uniformity of pace has a direct bearing on water resistance. Coaches recognize the importance of a proper pacing, although there is no unanimous agreement as to what the basis of a proper pacing should be. From a mechanical standpoint a proper pace can easily be defined as merely a uniform pace. Experiments showed that resistance becomes excessively high with every attempt to regain the lost speed.

The shape and the texture of the bathing suit also has a certain effect upon resistance. It was found that a well-made silk bathing suit does not increase the resistance to any appreciable extent, whereas a suit made of worsted may increase the resistance half a pound for a speed of five feet per second. A suit with a loose upper part and tight trunks acts as an anchor and may be the cause of considerable resistance when swimming.

Contrary to the findings of other experimenters, the present writer found that the resistance in the glide on the stomach is less than that of the glide on the back. The explanation of this disagreement may be found in the better technique used in the present study.

*The square here is an approximation; actually it is slightly more.



One of the high-speed transport planes, described in the article below, makes a striking picture against a background of other methods of transportation. The Hannibal Bridge across the Missouri at Kansas City is in the lower part of the photo

BUSINESS FLIES AT HIGHER SPEEDS

By REGINALD M. CLEVELAND

SPEED is the life blood of commercial aviation. To secure it, coupled with safety and comfort, the best aeronautic brains in the United States have been, and are, at work. The accomplishment in this direction, bearing in mind the adolescent immaturity of aviation as a whole, has been almost incredible. The accomplishments which lie ahead for this year of 1934 are hardly less astonishing.

We shall see a race in transport schedules which will make the historic competitions of the railroads in the era of competitive coast-to-coast runs look like an exciting contest among snails. We shall certainly see the map of the United States so shrunken by the devouring speed of scheduled air-transport that the time from New York to Los Angeles will be around 17½ hours, and in the reverse direction with the favorable prevailing westerlies, around 15 hours. The goal of an air journey between any two points in the United States without the loss of a business day will come close to attainment. Its significance will be emphasized by a much more extended use of sleeping planes with real berths.

BY the time this article reaches its readers, interested folk in the east as well as the west will have had an opportunity to inspect the new Douglas airliner, 41 of which, each powered with two Wright Cyclone 700-horsepower engines, and equipped with Sperry automatic pilots, will make up the fleet of Transcontinental and Western Air. Commander D. W. (Tommy) Tomlinson, one of the former famous trio of Navy "Sea Hawks," has been test flying this transport. It cruises, he says, on 62.5 percent engine power, at 183 miles an hour. Its top speed, with full load, is 217. Full load means 14 passengers, 600 pounds of cargo, and crew of three. Range, on 400 gallons, is 1000 miles; on 510 gallons, 1350 miles.

This plane is expected easily to maintain a "block to block" schedule of 160 miles an hour. Block to block is the form in which the airlines express their elapsed time from the start of taxiing away from the loading apron at one terminus to the moment the wheels stop rolling at the unloading block at another.

On this basis, schedules something like this are contemplated: Leave New York at 4 o'clock in the afternoon, leave Columbus at 6:15, leave Kansas City at 9:45—1097 air miles in 5¾ hours—leave Albuquerque at 2:30 in the morning, and arrive at Los Angeles at half past six in the morning. Or, reversing the picture, leave Los Angeles at 5:40 in the evening, and arrive at Newark at 11 the next morning. The hours given are local time to which must be added or subtracted the difference in time between terminals.

It must not be supposed that Douglas and T.W.A., as well as Pan-American

Airways, which has also ordered a small fleet of these transports for some of its land operations, will be left in undisputed possession of speeds of this kind. Far from it. United Airlines, largest of the transport companies, which has put behind it 60,000,000 miles of scheduled flying, will meet the challenge with its all-metal Boeings. The 247, outstanding accomplishment of the 1933 air-transport field, will be stepped up beyond its present very high speed by the use of geared Wasps, and there are rumors which will not down of a still larger and faster ship as well.

At the time of the All-American air races at Miami, the executive plane of the United company, powered with 14-cylinder geared Wasp Juniors, carried George S. Wheat and a party of newspaper men between New York and Miami at a pace which indicated what was to come. Controllable pitch propellers, which will be used on the line, were not fitted, but there was no difficulty in cruising at 170 and 180, with the engines turning up only about 2000 of their rated 2400 revolutions. Jacksonville to Miami, 329 miles, with cross and head winds, was flown in 1 hour, 47 minutes; Washington to Newark. 200 miles, in 1 hour, 5 minutes; Miami to Newark, 1210 miles, in 7 hours, 5 minutes flying time. The stepped-up Boeings will shrink the map as effectively as their rivals.

And there will be other very fast transports with rated top speeds above 200 miles an hour; the Lockheed Electra, the General Aviation tri-motored ships, the new Fairchild amphibian, and, perhaps, the Vultee.

IN its 19th annual report, the National Advisory Committee for Aeronautics told the Congress that increases in the speed of multi-engined airplanes, military and commercial, from 1932 to 1933 approximated 40 to 60 percent with practically the same engine power. Among the factors which have made this extraordinary accomplishment possible, many of them primarily based upon the study of the NACA at the world's most complete aeronautical laboratory at Langley Field, Virginia, the Committee lists the following:

The NACA cowling, the results on which were published in 1928, and the optimum location for engines, results of which were issued confidentially to the Army, Navy, and industry in 1930, and were kept confidential until 1932, when the first American airplanes embodying the results of these researches had been designed and constructed; the development by the Army, Navy, and industry, of reliable retractable landing gears; increased horsepower with the same size and weight of engines, involving increased revolutions per minute, higher compression ratio, improved fuels, and improved cylinder cooling; the development of satisfactory controllable pitch propellers; the development of new and more efficient wing sections; improved streamlining and use of flaps, assisted by the Committee's researches.

While the percentage of increase in cruising speed for transports cannot be expected to be as high for 1934 as it was in 1933, it still may confidently be expected to show a marked rise due to further utilization of the studies made at Langley Field, at Wright Field, in the wind tunnels of leading universities, and in the engineering departments of the aircraft and aircraft engine builders themselves. It will be due to still further elimination of drag, to still greater development of high lift devices, to better control of longitudinal and lateral stability, and to further pushing forward of engine and propeller efficiency.

THE immense significance of the new speeds for business and the business man are not yet fully realized. The executive in New York, facing an important problem in New Orleans, will be enabled to have dinner with his family and yet come in for a landing on the magnificent new Shushan Airport on Lake Pontchartrain in time to keep an early morning appointment. The sales manager in Seattle, disturbed by a telegram from headquarters in San Francisco, will be able to emplane after breakfast, have lunch with his associates at the Golden Gate, and be back in Seattle almost in time to close his own desk for the day. The Boston merchant, worried about pending legislation, will be able to finish his lunch on Beacon Street, and be in Washington, D. C., while the afternoon sun is yet high. The motion-picture star can easily put in a matinée personal appearance at Hollywood and walk on the stage in Times Square, New York, at 2 o'clock the next afternoon for another.

Before the year is out, the over-night journey in many instances can doubtless be made in a berth quite as comfortable and a good deal less noisy than the familiar lower over the shining rails.

And it must be remembered that the advantages of new speeds are not confined to the limits of continental United States. The business man and the traveler whose goal is Latin America, will also benefit by the acceleration of wings. On certain stretches of its far-flung network, Pan-American will fly Douglases, like those that are to knit the Atlantic and the Pacific for T. W. A., and Lockheed Electras, like those that are slicing off the minutes for Northwest Airways, up towards Spokane. The big new Sikorsky for Pan-American, too, will cruise around 150 miles an hour, with 32 passengers, across the Caribbean, and quite possibly before the year is out, be making the 800 miles from New York to Bermuda in six hours, or even pointing its questing prow beyond, to the eastward.

Nor is the saving of his own time the only way in which the American business man will find new benefits in 1934 from air transport. His important mails will, of course, share in the results of the higher speeds. Some of them will be carried, too, on the specialized mail ships, the swift Northrops and Lockheeds, still the romantic couriers of the night, but more agile, nerved to a swifter pace, better armed than ever before against the hazards of fog and ice.

GOODS also—important samples, styles, film, documents, and perishables—will shuttle across the invisible warp and weft of the airways at the same headlong pace that carries the air traveler upon his mission. A new horizon will have been opened for the alert man of business. The merchant will find his zone of reasonable coverage immensely expanded; the flower and fruit grower will be able to make the most of distant and formerly unobtainable markets; the buyer on the Pacific coast will need only to be 18 hours behind New York in the display of the latest Paris gown.

Finally, the new speeds of air transport have significance as a bulwark of national defense which is too little appreciated. Fleets of transport planes, able to carry 20 men each in 600- to 800-mile jumps at 200 miles an hour, mean a mobility for specialized groups that could be attained in no other way short of magic. In an emergency, an entire anti-aircraft unit, with its sound locators and 800-million candlepower searchlights, its trained personnel and its rapid-fire guns, could be whisked from coast to coast almost overnight. The ground organization which makes possible in large measure these scheduled speeds in the air—the airports; the repair bases; the immense privately operated weather services, in addition to those of the government; the plane-to-plane and plane-to-ground radio communication—all could not fail to have military significance of the highest importance.

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The foregoing article accurately outlines the situation in the air-transport and airmail fields at the time of writing. Just before this issue went to press, however, the government investigation of airmail activities by the large transport companies of this country placed the whole matter under a cloud, and the outcome is still not apparent. How the airmail will be carried in the future depends upon the findings of the present investigation. —The Editor.

Refrigerator to Cool Boulder Dam Concrete

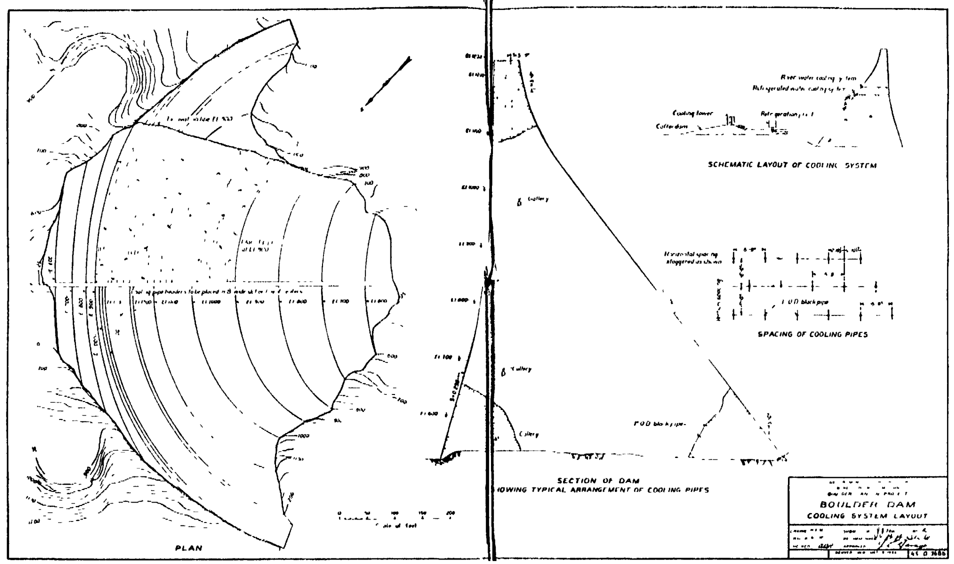
THE mass concrete being placed in Boulder Dam which is now under construction by the Bureau of Reclamation of the United States Department of the Interior in the Black Canyon of the Colorado River near Las Vegas, Nevada, is being artificially cooled during its setting or hardening period. This is an important innovation in the art of mass concrete construction, and is made necessary by the unprecedented dimensions and other conditions involved.

The chemical reactions which accompany the setting of the Portland cement in concrete release a considerable quantity of heat which in this case may be expected to raise the temperature of the concrete mass an average of about 40 degrees, Fahrenheit, above the temperature at which it is cast. While the concrete begins to harden and lose its plasticity within an hour or so, the setting process is not completed for a long period of months although the generation of heat becomes negligible after a few weeks' time.

Concrete expands and contracts with changes in temperature and therefore has a greater volume when it has a high temperature due to the setting heat of the cement than when this excess heat is later dissipated and the concrete assumes the temperature of its surroundings. As the mass concrete shrinks in this process, it opens up the construction joints between the adjacent blocks in which it is poured. The open joints are afterwards filled with cement grout under pressure to render the structure monolithic.

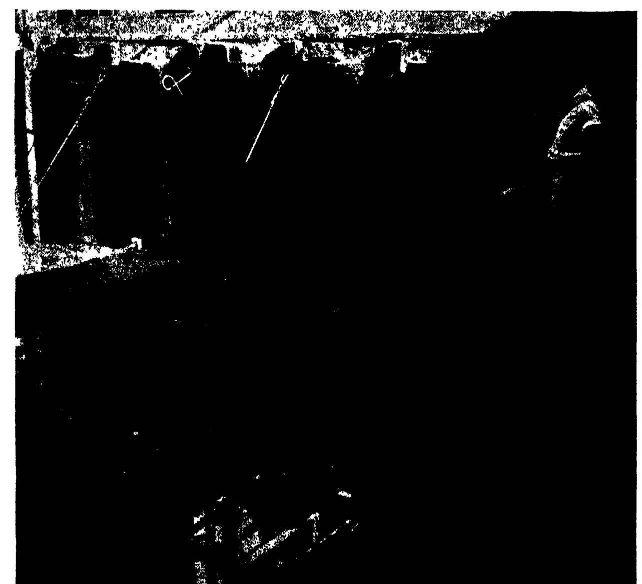
IF the cooling process is incomplete when the joints are grouted, harm may result since the possibility of adjustment between different parts of the dam no longer exists and the dam, which is restrained by its connection to the abutments, can then make the necessary adjustments only through elastic distortions with their accompanying stress changes or, if these become too severe, by actual rupture of the material of the dam to form cracks along which the necessary movements can take place. Failure of a dam as a whole would not occur as a result of these readjustments but they are detrimental to the extent that they decrease the safety and shorten the life of the structure. The purpose of the cooling is therefore to bring the shrinkage to completion before the dam is made into a structural unit by the grouting process. The cooling will also permit more effective grouting due to the wider openings to be obtained at the construction joints. A good job of grouting is essential if even distribution of stresses throughout the dam and a proper distribution of the loads to the abutments are to be obtained.

The amount of excess temperature at the end of the construction period depends to some extent upon the rapidity with which the construction is carried on, but more directly upon the dimensions of the dam. A study of the laws of cooling reveals that the time required for such a structure to lose a given proportion of its excess heat by natural processes is, if other things are equal, proportional to the square of the thickness. Thus, while a concrete wall five feet thick would lose about 90 percent of any excess temperature it might have above that of its surroundings in less than a week, a wall 50 feet thick would require approximately a year and a half, and a structure 500 feet thick would require a century and a half to lose the same proportion of heat. The thickness of the Boulder Dam will vary from 45 feet at the top to about 660 feet at the bottom. It is therefore sufficiently massive to require that some means be employed to accelerate the return of the concrete to normal temperatures if it is to be brought to a stable condition at the end of the construction period.



Right: Plan and elevation of Boulder Dam with sections showing the layout of the elaborate piping system used in cooling the concrete mass while it is setting

Below: The ammonia compressors in the refrigerating plant. It will be noted that large compressors are necessary—sufficient for a sizeable job of cooling



Below: Cooling pipes in place on a cement pour. These pipes are laid on five-foot nine-inch centers, horizontally, and on five-foot centers vertically. Totalling many thousands of feet throughout the mass of the dam, these pipes will, of course, have to be left in place. They will thus act as reinforcing rods in the finished concrete structure

Illustrations courtesy Bureau of Reclamation

THIS excess heat in the concrete at Boulder Dam is being removed in a relatively short period of time by circulating cold water through one-inch diameter horizontal steel pipes embedded therein as the concrete is placed. The pipes are spaced approximately five feet nine inches center to center throughout the mass. The drawing indicates the enormous footage of pipe used and the manner in which it is laid and spaced.

A large refrigerating plant and cooling tower provide the necessary equipment for cooling the water. The construction contractor supplies the ammonia compressors for the refrigerating plant by installing the proper type of cylinders on air compressors which had been previously used in the work of driving the tunnels. These units have sufficient capacity to produce about 600 tons of ice per day.

The cooling tower is designed to cool a flow of 6000 gallons of water per minute. A part of the cooled water from the tower is used to carry away the heat discharged from the refrigerating plant and the remainder is pumped directly to the dam through a 14-inch diameter main and there distributed by means of headers to the pipe embedded in the concrete. The heated water is collected in a second 14-inch diameter main and returned to the cooling tower. More than half the total heat will be extracted by means of water pumped directly from the cooling tower and the embedded pipes will then be connected to the refrigerating plant which will bring the cooling process to completion. Approximately one foot of embedded pipe is required for each cubic yard of concrete to be cooled.

Sundials and Their Construction—III

The Construction of North, East, and West-Facing Dials, and Polar Dials

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory

DIRECT vertical dials are seldom placed on walls, because they must face the cardinal points of the compass. Since few walls face the cardinal points, the four direct vertical dials are usually combined on one plinth, and this combination is known as the pillar dial. Many pillar dials are left blank on the north face; but if the north dial is added, the pillar dial will then be complete and, owing to the brief time the sun shines upon the north face, sufficient room may be left for a suitable inscription, which is often placed on this face in place of a dial.

The preceding article described the construction of the direct south vertical dial. The construction of the direct north, east, and west vertical dials, is as follows:

THE plane of a north dial (Figure 3) is perpendicular to the plane of the horizon and faces the true north. The diagram shows the construction of the hour lines for latitude 48°30′.

The style points to the celestial pole.

The substyle is the 12 o'clock line and lies in the plane of the meridian.

The height of the style is equal to the complement of the latitude, which in this case is 41°30′ (90°—48°30′=41°30′).

Draw the horizontal line *FAG*, Figure 1. (This will be the 6 o'clock line.)

At *A* draw the line *AC* perpendicular to *FAG* (This will be the 12 o'clock line.)

Draw *AD* so that the angle *CAD* is equal to the height of the style, or 41°30′.

From *B*, on *AC*, draw *BE* perpendicular to *AD*.

Make *BC* equal to *BE*; then make *FA* and *AG* each equal to *AC*.

Draw lines *FC* and *CG*. Through *B* draw a line parallel to *FAG*, cutting *FC* at *L* and *CG* at *M*. Through *L* and *M* draw lines *LK* and *MH* parallel to *AC*.

With radius *BC* and centers at *F* and *G*, describe the arcs *PQ* and *SR*. Divide these arcs into equal parts of 15 degrees each. Draw lines from *F* and *G* through the points thus found, until they cut the lines *LK* and *HM*, respectively.

From *A* draw the required hour lines through the points found on *LK* and *HM*.

Figure 2 shows the hour lines transferred to the dial plate, and the way in which they should be numbered.

Figure 3 shows the position of the dial when in use.

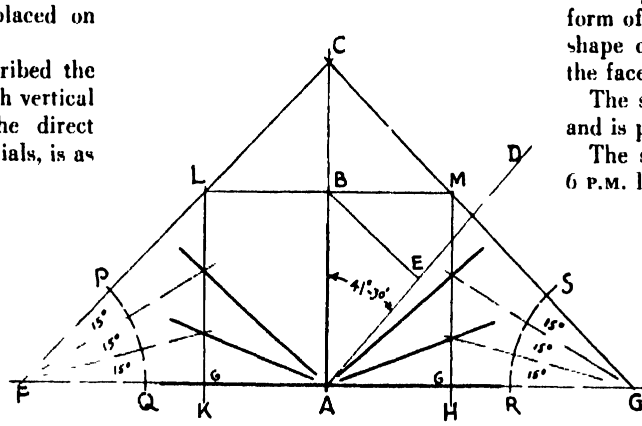


FIGURE 1

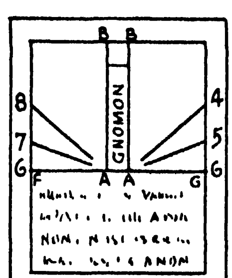


FIGURE 2

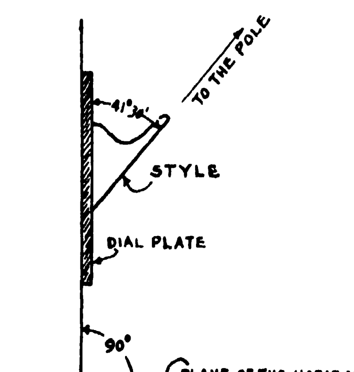


FIGURE 3

The sun will not shine upon this dial between the hours of 6 in the morning and 6 at night; therefore it is necessary to inscribe on the dial plate only those hours from sunrise to 6 A.M. and from 6 P.M. to sunset.

This dial must be placed in a perfectly vertical position, so that the substyle line lies in the plane of the meridian and the face of the dial looks to the true north point of the horizon.

THE planes of the direct east and west vertical dials (Figure 5) lie in the plane of the meridian, and for this reason they are sometimes referred to as meridian dials. The hour lines for each dial are calculated in exactly the same way, so it is necessary only to describe the construction of one of them. Figure 4 shows the construction of the hour lines for the east dial, in latitude 52°30′.

The gnomon is usually made in the form of a flat rectangular bar or in the shape of a pin. It is perpendicular to the face of the dial.

The style points to the celestial pole and is parallel to the dial plate.

The substyle is the 6 A.M. line (the 6 P.M. line in the west dial) and points to the celestial pole.

The height of the style is measured in inches, and is determined by the size of the dial. It is usually from $2\frac{1}{2}$ to 3 inches in height.

The hour lines are parallel to the substyle.

The construction is as follows:

Draw the horizontal line *AC* (Figure 4). This represents the plane of the horizon.

At *B*, on *AC*, draw *DE* so that the angle *EBC* is equal to the latitude of the place (52°30′). *DE* will also be the substyle line and the 6 A.M. line.

Make *BD* equal to the desired height of the style in inches. Through *D* draw the line *KL* perpendicular to *DE*.

With *B* as a center, and the radius *BD*, describe the arc *GDH*. Beginning with the point *D*, divide this arc into equal parts of 15 degrees each, on each side of the line *DE*. From *B* draw lines through these points until they cut the line *KL*.

Through the points thus found on *KL*, draw lines parallel to *DE*, which will be the required hour lines.

Figure 5 shows the hour lines transferred to each dial plate. Note the position on each dial.

Figure 6 shows the most commonly used gnomon on this type of dial.

The east dial will show only the hours from sunrise to noon; the west dial, the hours from noon to sunset. These dials

will not show the noon hour, because they lie in the plane of the meridian. The sun's rays at that time are parallel to the face of the dial; therefore the shadow cast by the gnomon will be infinite in length, and the edge of the shadow cannot be seen.

The plane of each dial must be perfectly vertical, and lie in the plane of the meridian.

THE equatorial dial and the polar dial are reclining dials, but take their names from the planes in which they lie. For this reason they are not usually classed with the reclining dials.

The plane of the polar dial is parallel to the axis of the earth (Figure 9), and, if produced, would cut the celestial pole. Figure 7 shows the construction of the hour lines for any latitude.

The gnomon is usually made in the form of a flat rectangular bar or in the shape of a pin, and is perpendicular to the face of the dial.

The style points to the celestial pole and is parallel to the face of the dial.

The substyle is the 12 o'clock line and lies in the plane of the meridian, and if produced would cut the pole.

The height of the style is measured in inches and is determined by the size of the dial. It is usually placed about $2\frac{1}{2}$ to 3 inches above the face of the dial.

The hour lines are parallel to the substyle.

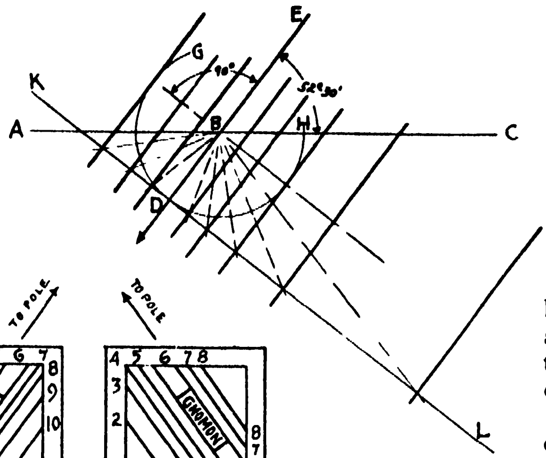


FIGURE 4

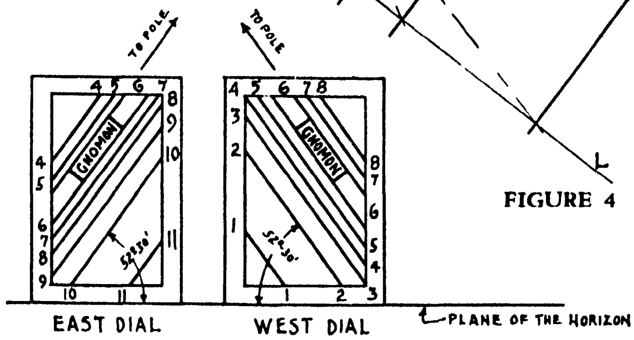


FIGURE 5

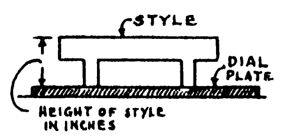


FIGURE 6

The construction is as follows:

Draw the horizontal line *AC*.

At *B*, on *AC*, erect the perpendicular line *BE*. (This will be the 12 o'clock line and the substyle.)

Make *BD* equal to the desired height of the style, in inches.

With *D* as a center and the radius *BD*, describe the arc *FBG*. Beginning at *B*, divide this arc into equal parts of 15 degrees each, on both sides of the line *BD*.

From *D* draw lines through the points found on arc *FBG*, until they cut the line *AC*. From the points thus found on *AC*, draw lines parallel to *BE*, which will be the required hour lines.

Figure 8 shows the hour lines transferred to the dial plate, and the proper way of numbering them. Figure 9 shows the position of the dial when in use.

It is necessary to show on this dial only those hours between 6 A.M. and 6 P.M., because the plane of the dial, if produced, would cut the east and west points of the horizon. At 6 in the morning and 6 in the afternoon the shadow cast by the gnomon is infinite in length; therefore the 6 A.M. and 6 P.M. lines cannot be placed upon this dial.

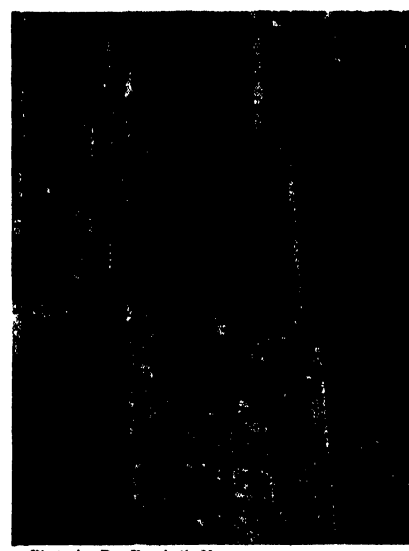


Photo by Dr Frank S Hogg

A dial of the vertical declining type, high up on the wall of Ely Cathedral, one of the oldest of the cathedrals of England. As the gnomon is light such a dial will not long remain intact unless it is placed well out of reach of the hands of persons of a too investigative turn of mind, also of vandals

When setting the dial elevate the plate above the plane of the horizon, at an angle equal to the latitude of the place, as in Figure 9, and orient the dial so that the 12 o'clock or substyle line lies in the plane of the meridian. If this is done correctly, the style will then point to the celestial pole.

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This article concludes the description of the regular forms of the sundial. The next article will deal solely with the vertical declining dials.

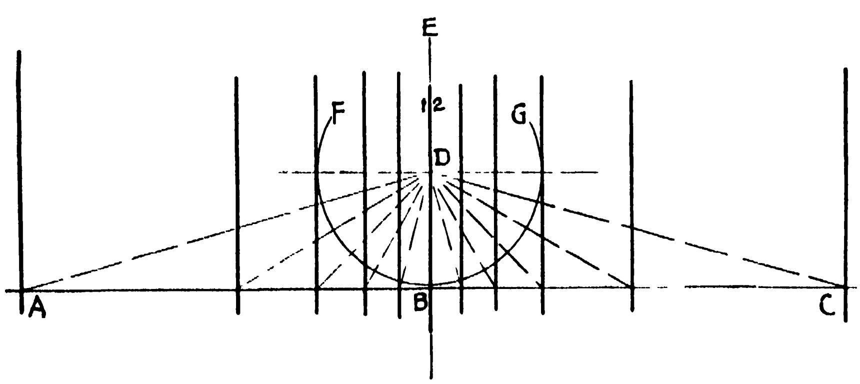


FIGURE 7

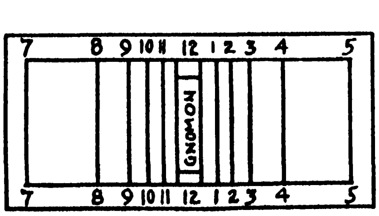


FIGURE 8

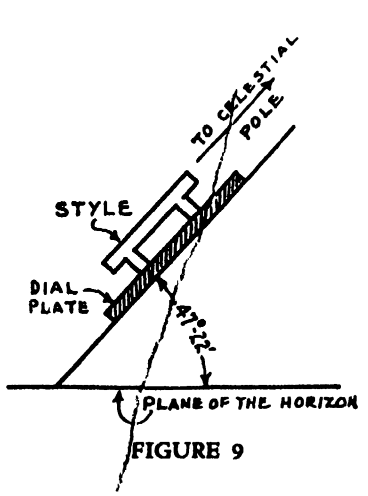


FIGURE 9

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

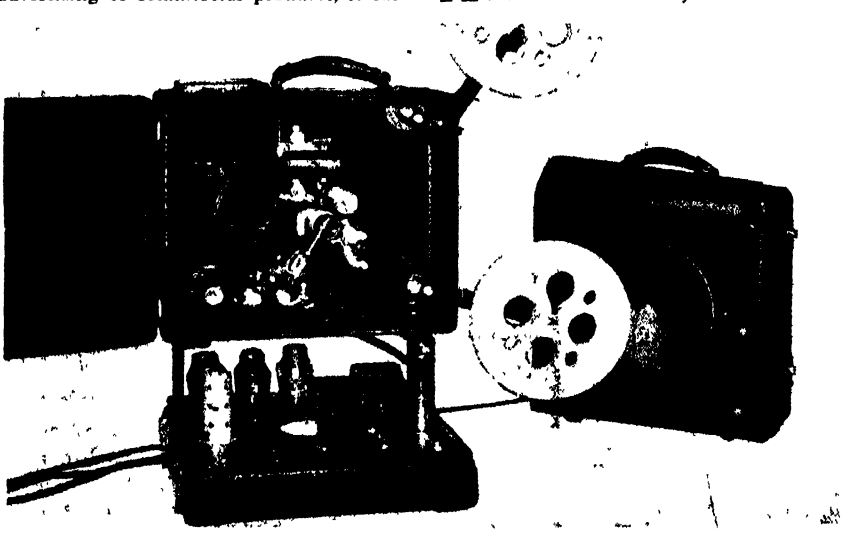
Talkies in a Suit Case

IT is just as much a scientific achievement to refine existing processes or machines, as it is to discover new ones. The term *refinement* is especially applicable to reducing weight and bulk in machinery, and it is happening conspicuously in the "talkie" projector field, just as was the case with the silent movie.

The new DeVry 16-millimeter sound-on-film projector succeeds in packing an elaborate theater installation—hitherto measured in ton units, and filling two trucks—into two small suit cases that weigh but 55 pounds, total.

In the first place, 16-millimeter film is one quarter the area of 35-millimeter film, and, in a general way, permits a reduction to one quarter the size, weight, and cost of a theater installation. A refinement in the size of photographic silver grain on the film emulsion permits as delicate response to sound images as the larger sound track. Increases in power in small projector lamps up to 750 and 1000 watts provide ample illumination for audiences up to 1500 Suitcase construction gives necessary rigidity and handy portage. Photo-cells and exciter lamps have been stepped up in efficiency in the smallest sizes, and amplifiers and loud speakers have followed suit.

The result is a form of entertainment and instruction now within easy attainment of schools, churches, and business. For the advertising of commercial products, it furnishes the salesmen and executive, in two small cases, the one appeal that attracts and holds the attention of the masses old and young, educated and uneducated alike.



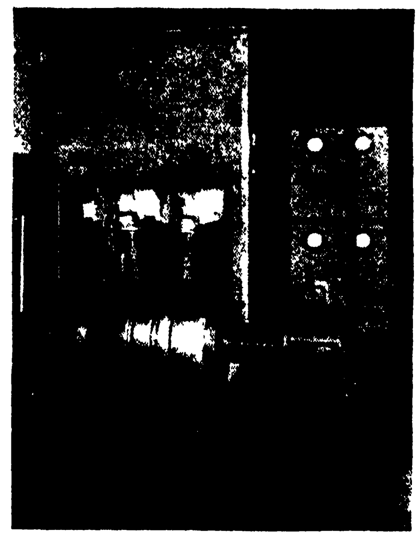
The two units of the talkie in a suit case equipment

This Factory Can't Stop

TWO plants to make one product are necessary in sulfur mining by the American process of melting the sulfur underground and pumping it to the surface, says Lawrence O'Donnell, in *Chemical and Metallurgical Engineering*. And once the plant is started, it can't be shut down, but must operate until the sulfur is exhausted. If the factory stopped for any reason, the hot liquid sulfur in pipes and pumps would solidify, causing immense damage and loss. Hence, all the boilers, heaters, pumps, and piping systems are built in duplicate, so that if one fails, the other can be thrown into service.—*A. E. B.*

Machine Welds Beer Barrels

AN automatic machine for arc-welding metal beer barrels by the shielded arc process has been announced by The Lincoln Electric Company, Cleveland, Ohio. The machine is reported to have a production capacity of 30 barrels or more per hour, depending upon the type and size of barrel.



Welding a metal beer barrel

The machine is made for producing barrels of different types of construction according to the manufacturer's requirements. Barrels welded by this machine are either single or double shell types. Both inner and outer shells of the latter type are automatically welded with this machine.

High Strength Copper Alloys

THE ancients discovered a so-called method of hardening copper, the secret of which is said to be lost. In recent times similar methods have frequently been rediscovered but all of them, both ancient and modern, involve the use of alloying elements which have reduced the electrical and thermal conductivity.

For use in commutators, slip rings, and other electrical devices, a hard metal is necessary and high conductivity of heat and electricity very desirable. A new group of copper-base alloys, called Cupalloy, has a most interesting combination of desirable characteristics. Cupalloy is much harder than pure copper, with much higher elastic strength, and the electrical conductivity ap-

Dr. John Martin Hiss measuring a foot by means of the Classifootometer described in these columns

proaches that of pure copper. Furthermore, the creep strength of this alloy is considerably greater than that of cold-drawn copper and the strength does not deteriorate with time at elevated temperatures as is the case with cold-drawn copper.

Many interesting tests have proved the qualities of this group of alloys but due to its newness it is not yet in commercial use.—*A. E. B.*

A Doctor's Foot Classification Instrument

ARE you a pedevert? You need not be too alarmed if you do fall into that class, for you have a lot of company. Fully 40,000,000 people in America are pedeverts.

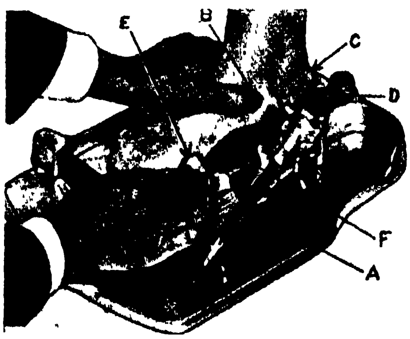
It isn't strictly speaking a disease, but if you turn your feet outward when you walk, you are in the pedevert class. Or you may be a digiped; that is, if you can sport a bunion or a nice case of so-called "hammer" toes.

If you are one of those lucky few who have normal feet, you are a pedalign type. A flat footer or a hollow-footed (unusually high-arched) individual goes into the pedeform class while the possessor of a pair of rigid, painful feet goes into the "inflaped" class.

Today you can have your feet classified in the above manner and can, therefore, know exactly what kind of feet you have. You can thus be sure of having shoes fitted accurately by scientific measurements.

The system was originated by a Los Angeles orthopedic surgeon, Dr. John Martin Hiss, for use with his own patients, and is today being adopted throughout the country by doctors and shoe men alike.

Doctors have long been handicapped in treating foot ills by the fact that they could not be sure of having their patients correctly fitted in shoes. There was no common



Close-up of the Classifootometer, showing the various parts, and how the foot is placed in order to obtain measurements for fitting shoes

language between themselves and shoe dealers, because there was no classification system and no instruments to determine types of feet.

Foot trouble was generally diagnosed as "broken arches," with no attempt being made to distinguish degrees of bone displacement or of testing feet against a standard.

Dr. Hiss' system is the first attempt to bridge the gap between the medical profession and shoe fitters. Termed the Classifoot System of Shoe Fitting, it consists of an instrument, known as the Classifootometer, and a manual of instructions. The instrument is used to measure feet and also to spot variations of each foot from the normal. This is done in degrees (of a circle) and is therefore named the Metric Foot Test. The manual of instructions describes the five classes of feet mentioned above and the 14 types under them, and explains the methods of fitting shoes under the system. Because the system is adaptable for use in both the doctor's office and the shoe fitting room, it is proving to be the needed common denominator.

Beverage Alcohol

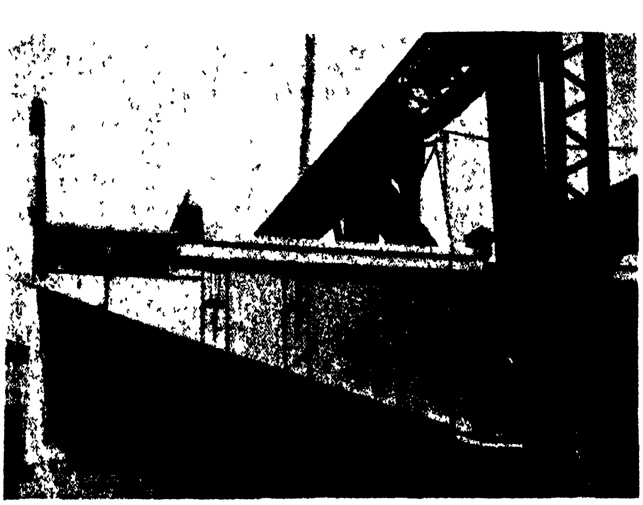
THE repeal of prohibition has brought many new problems to industry, not least of which is the predicament of the producers of grain alcohol. Every chemist knows that alcohol produced from grain is identical with the alcohol produced from molasses. However, the Government regulations covering distilleries specify that only the alcohol derived from domestic grains may be used for beverage purposes. This rule is obviously designed to alleviate the farmer's plight by giving him a new market for his grain, but it apparently closes the door on the industrial alcohol producers, most of whom use "blackstrap" molasses as a raw material.

Producers of alcohol who use molasses and sugar as raw materials have entered vigorous protests against this feature of the marketing agreement. These objections, however, appear to have been overruled as reports from Washington state that although producers of alcohol from molasses and products other than grain are voicing vigorous objections to the provisions in the distillers' marketing agreement which restricts the use of their product in the manufacture of alcoholic beverages, the AAA does not contemplate altering present regulations.—*A. E. B.*

Welding Reduces Weight of Remodeled Bridge

ARC welding played an important part in reducing the weight of the recently remodeled and widened University bascule bridge at Seattle, Washington. Traffic on the bridge, built some 17 years ago, had increased from 8000 vehicles per day in 1919 to 38,000 per day in 1931 when it was decided to widen the bridge.

Widening was accomplished by building roadways outside the bascule trusses. These traffic lanes are supported on arc-welded brackets securely tied to the floor beams through slots cut in the vertical truss members. The brackets have tapered bottom flanges and vertical stiffeners are welded to the web. The stringers extend through slots in the bracket webs and have plates welded to the upper and lower flanges.



Bascule leaf raised to show outer roadway brackets of remodeled bridge. Welding was used in all shop fabrication

Arc-welded brackets and stringers for outer roadway in foreground; old sidewalk brackets show in background

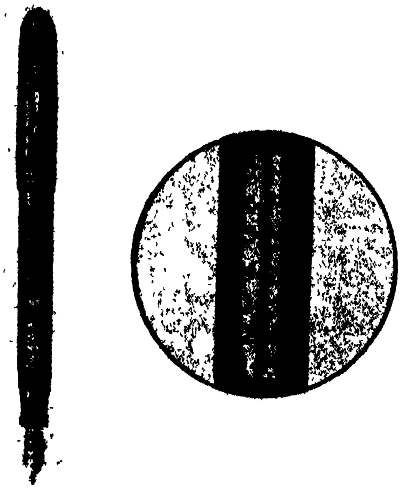
Hand rails for the bridge were also arc welded.

Welding was done by the Puget Sound Bridge and Dredge Company, contractors for widening of the span. All welding was done with equipment manufactured by The Lincoln Electric Company.

"Word Gauge" Fountain Pen

THE "Word Gauge" is the newest thing in the writing equipment industry. This new device enables the writer to learn by a glance at his pen just about how many words he has written since he filled the pen and how many he can write with the ink remaining in the pen.

The "Word Gauge" was developed by the engineering department of The Conklin Pen Company and is standard equipment on one of the models of the Conklin Nozac, a sackless fountain pen made by that company. The "Word Gauge" is a scale engraved on the transparent ink section of the barrel of the pen and on which the ink level inside the barrel indicates in thousands the number of words written since the pen was filled, and the remaining writing capacity in words.



Fountain pen with built-in "word gauge": *Circle;* close-up of gauge

Although ink capacity of a pen measured in terms of cubic centimeters and comparative percentages are common, such computations fail of significance in indicating actual word capacity. To determine the actual word capacity of the Conklin Nozac a pen selected from stock and filled was put into the hands of a professional amanuensis and she was told to write it empty. The writer worked steadily for 9 hours and 27 minutes, time out for food and rest not being included in the figure. When the last drop of ink had been used it was seen that she had written 7034 words. The transparent ink chamber of the pen was then divided into 7 equal sections, these bearing legends of 1- to 7-M.

Novel Engine Arrangement

TWO-CYLINDER opposed, and four-cylinder opposed aircraft engines have been made in the past. Now Captain Robert W. A. Brewer, a well-known aviation pioneer, has brought out an eight-cylinder opposed motor, which can be mounted either vertically or horizontally at the nose of an airplane. As can be seen from one of the photographs, the engine is very compact, and above all very narrow. Therefore when mounted vertically it impedes the pilot's vision very little indeed—much less than the radial air-cooled type. With the four cylinders in line and suitably cowled in, the air is admitted through a comparatively small opening at the front end and the air resistance of the engine is small.

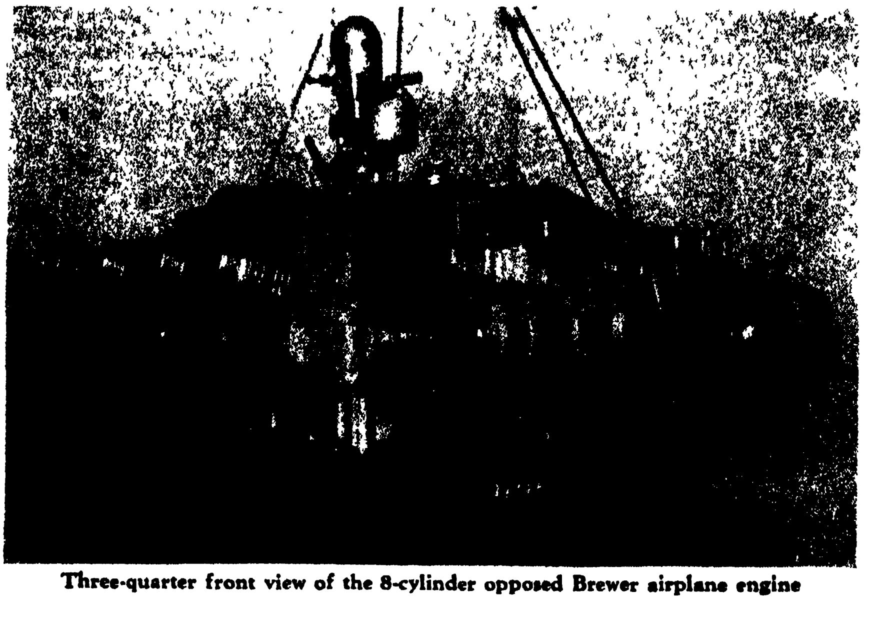
Another original point in the design is that the motor can be mounted directly upon the firewall, hung in cantilever fashion. Six mushroom-shaped feet are provided at the rear of the crankcase, and rubber washers are placed between these feet and the firewall. This means that demountability is good, and torsional and other vibrations are not transmitted into the fuselage.

The designer has also provided flexibility in the mounting of the carbureters. These can be either of the vertical updraft, downdraft, or horizontal type. Cylinders and heads are all similar and are so mounted on the crankcase that all nuts can be operated by speed wrenches. Two complete sets of oil pumps—scavenger and pressure—are mounted in the line of the vertical drive, and each can be removed without disturbing the valve gear. Each unit part is self contained; for example, the over-head valve gear comes down without disturbing any other parts.

The Brewer engine mounted vertically, showing compact arrangement

With these features, the engine, while working on conventional principles, has a decided appeal for those who have to consider maintenance and servicing problems.

Compact in overall dimensions, the engine delivers 158 horsepower at 2200 revolutions per minute and weighs 428 pounds including oil tanks, but without propeller hub or starter. Bore is 4¾ inches, and stroke 4¼ inches. —*A. K.*



Three-quarter front view of the 8-cylinder opposed Brewer airplane engine

How to Make an Airplane Quiet

WE recently gave the views of American authorities on the subject of reducing the noise of an airplane cabin. Dr. A. H. Davis gives an equally authoritative English view in *Aircraft Engineering.*

The propellers should be geared down. When the propeller tips are revolving near the speed of sound, they give off a piercing and powerful noise which should be avoided, even though the gearing itself introduces some noise.

The noise of the engine valves is hard to reduce. Perhaps the sleeve valve would be a step in the right direction. Also, since noise may be transmitted by resonant vibration, the engines should be as well balanced as possible, and, if possible, should be rubber mounted. It is preferable, of course, not to place engines in the nose of the fuselage. The exhaust should be carefully led under the wing. The propellers should not be mounted in line with the cabin, nor for that matter in line with the pilot's cockpit—it is the baggage compartment alone which should be permitted to be in the vertical plane of the propeller rotation.

Noise precautions do not end here, however. For example: Air borne noise can be diminished by avoidance of open windows, and cracks and gaps 'round doors. Resort to artificial ventilation is indispensable, and the inlet for the ventilating air must be placed where noise is least—say at the very front end of the fuselage.

Furthermore, the cabin must be insulated

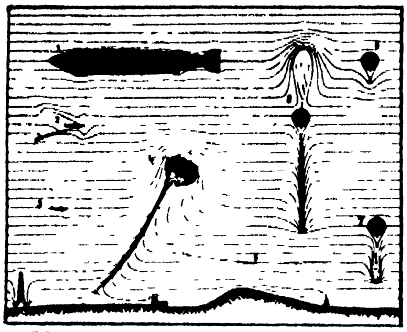
against noise penetration as far as possible. Windows should be heavy—say 3/16-inch glass, and to keep down window weight, they should not be too large. The cabin walls should be built up of an outer reflecting skin of metal, an inner lining of plywood or imitation leather, with a fluffy material such as "kapok" or "eelgrass" in between.

The cabin itself should be provided with noise absorbent material, such as soft curtains.

With all these rules kept in view, truly remarkable results can be achieved.—*A. K.*

Lightning and the Airplane

THE dangers of lightning in aircraft work are the subject of many conflicting views. Sometimes it is said that the airplane is not in electrical connection with the earth, cannot "draw" electricity, and is therefore immune to lightning dangers. Sometimes the opinion is given that if an aircraft runs into the path of a lightning discharge, it must be immediately destroyed by the powerful current or at least burst into flames. The correct view of the situation lies somewhere between these two extremes.



How various types of aircraft distort the electric field of the atmosphere. 1; dirigible. 2; airplane with antenna. 3; airplane without antenna. 4; captive balloon. 5; towed glider. 6; free balloon. 7; free balloon releasing ballast. 8; free balloon valving gas and with wet drag rope. See discussion of lightning and airplanes in these columns

Heinrich Koppe, a German meteorologist, writing in scholarly fashion in *Zeitschrift für Flugtechnik* sets us all straight.

The earth is an excellent conductor. The atmosphere is a poor conductor up to a height of about 50 miles. Above the 50 miles the very thin air is again an excellent conductor. The earth and its surrounding atmosphere therefore constitutes a species of gigantic condenser. Between the two "plates" of this condenser there flows a very small but perceptible "ionic" current, the ions being split-up molecules. This electric current is 1360 amperes for the entire surface of the earth. It is induced by the famous cosmic rays.

Since there is an electric current between the outer thin air and the earth's surface, there is a potential difference between the two parts of the condenser. The entire voltage difference is 200,000 volts. This sounds large, but the actual pressure gradient is slight, because the distances involved are so great. In the atmosphere there are lines of equal electrical potential or pressure, which lines are normally parallel to the earth's surface.

The presence of flying objects in the air distorts the electrical field in the manner shown in one of the diagrams. This distortion is much less for an airship, which lies parallel to the lines of equal potential, than for a free balloon whose axis of length is perpendicular to the potential lines. The airplane alone distorts the lines much less than the airplane equipped with a long trailing antenna.

When the electric lines are distorted, the pressure gradients between adjacent lines become much greater. The airplane with trailing antenna can multiply the pressure gradient by 10 or even 20.

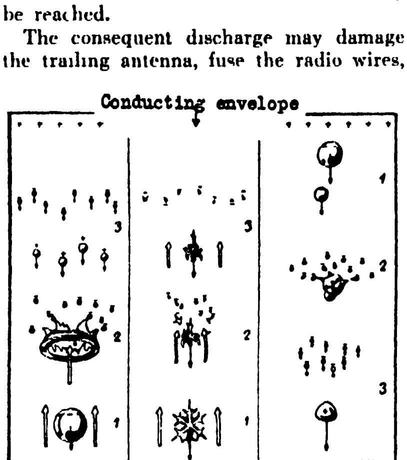
Now when rain drops are acted upon by a violent wind, the molecules may be split. Relatively heavy positive ions continue their downward path; light, negatively charged ions are thrust upward, and the normal pressure gradients are far exceeded.

There is a critical pressure gradient at which electrical discharges occur; namely, when there is a difference of 30,000 volts in pressure for one centimeter of distance.

It is very rare indeed that an airplane is struck by the ordinary lightning discharge, because airplanes do not fly in typical thunder-storm weather. Such weather gives ample warning to the pilot with even negligible knowledge of meteorology, and the weather services are always on the lookout for thunder-storm conditions

The danger lies rather when gusts of wind and rain drops or snow flakes have made conditions propitious not for one of nature's own discharges, but have simply raised the gradient to say 3000 volts per centimeter. Then if the airplane multiplies this value by ten by distortion of the electric lines, the critical value of 30,000 may be reached.

The consequent discharge may damage the trailing antenna, fuse the radio wires, damage the tanks, even cause a fire. No airplanes of any type are immune to electric trouble. Cases of serious damage have been noted in the all-metal type just as in the stick and wire type of airplane.

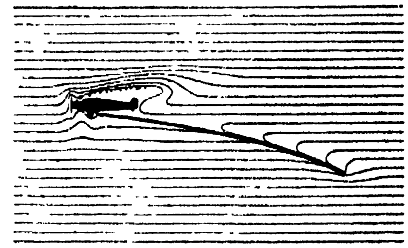


How splitting up of rain drops or snow flakes leads to formation of strong atmospheric electric charges

The dangers of electric discharge, however, have been much over-rated. The electric discharge strives to pass from the tip of the antenna or other point of voltage breakdown to the very tip of the machine, where is found the heavy metal mass of the engine.

In the all-metal airplane, there is the protection of the conducting metal skin. Even in wooden type fuselages there are always wires or other conductors which may lead the discharge past the occupants without great physical injury.

Nevertheless it is not pleasant to think that the airplane can make its own lightning flash. The precautions to be observed are first of all a recognition by the weather services that conditions leading to electric discharge may be present even when the sky is free from ominous lightning discharges. Secondly, metallic bonding or shielding, from tail to tip, so that the current will always have a ready path to follow and one which does not lead through the bodies of the occupants, or the gasoline tanks. It may be advisable, for example, to have the propeller copper bonded to the engine. Thirdly, either the elimination of the trailing antenna or particular care in shielding it electrically. Even in the case of the antenna which is mounted above the body of the airplane some bonding precautions are essential.



Field distortion caused by airplane flying with trailing radio antenna

Our story may be lengthy, but it is better to know than to listen with credulity to some of the yarns which circulate in hangars and on the flying field!—*A. K.*

Activated Alumina—A "Chemical Sponge"

A CHEMICAL sponge, with which moisture can be "sopped up" from air, or other gases, "squeezed out," and used over again, is the latest tool of the chemical engineer, made possible by the introduction of activated alumina by the Aluminum Company of America. Activated alumina (oxide of aluminum) is a white granular substance which is chemically inert and which will selectively adsorb moisture, not only from gases and vapors, but also from liquids and solids. It will adsorb moisture from air and gases at 100 percent efficiency until it has increased in weight from 12 to 14 percent and will thenceforth continue to adsorb at lower efficiencies until a 20 to 25 percent weight increase has been reached. When saturated, it may be reactivated by aspirating heated gases thru the activated alumina or by radiating heat from an electrical element or from hot oil or steam coils. After reactivation and cooling, the adsorbent is again ready for service and there is practically no deterioration in its effectiveness with continued use.

Applications of activated alumina embrace many uses, typical examples of which follow: Drying gases, dehydrating liquids, drying refrigerants, air conditioning (household and industrial), clarification of liquids, solvent recovery, gas masks and canisters, removal of oil vapor from compressed gases,

drying air for blast furnaces, cupolas, converters, and so forth, catalyst and catalyst carrier, conditioning of warehouse atmospheres, complete drying of air, selective gas adsorption and purification and deodorizing of gases, liquids, and solids.—*A. E. B.*

Seaplane Terminals for Cities

QUITE recently Eugene L. Vidal, Director of Aeronautics in the Department of Commerce, announced the allotment of 10,000,000 dollars for the purpose of establishing 2000 aircraft landing fields.

George B. Post, of Edo Aircraft, the constructors of the floats used by Colonel

George B. Post, who suggests seaplane terminals for large cities

Lindbergh in his recent 30,000 mile tour, suggests that 2 percent of this amount might be profitably employed in establishing seaplane facilities. Mr. Post advances some excellent arguments.

For example: If New York were provided with adequate seaplane passenger facilities, and if at the same time similar facilities were provided in the waters of a number of nearby cities such as Boston, Albany, and Philadelphia, the elapsed time between cities would be reduced by at least 30 to 60 minutes—a saving of perhaps 50 percent of the elapsed time under present schedules.

Not only would the centers of cities be brought closer together by such seaplane terminals, but the world's largest commuting populations would be immediately interested. There are seaplane commuters now, in spite of the lack of facilities. Thus Richard F. Hoyt, Chairman of the Board of Curtiss-Wright Corporation, commutes daily in the summer between Lloyds Neck, Long Island, and his office in down-town New York. In the absence of any seaplane passenger terminals Mr. Hoyt lands in the East River, taxies up to a pier at the foot of Wall Street and scrambles up the side of the most convenient tug boat or barge. We cannot expect all our possible air commuters to be similarly athletic and adventurous.

Mr. Post, after a careful study of the situation, believes that suitable water terminals could be constructed at a trifling cost. They would be of the type described in a recent issue of SCIENTIFIC AMERICAN, and could be placed in operation for between 10,000 and 12,000 dollars. These terminals would consist of wood or steel barges, providing storage space for a limited number of planes, with accommodations for passengers and an operator. One end of the barge would be fitted with an inclined turntable, such as shown in the photograph, which would provide a means of removing seaplanes and amphibians from the water and turning them about in the same operation.

We believe that Mr. Post's suggestion is thoroughly deserving of support.—*A. K.*

"Everyman's" Aerial Camera

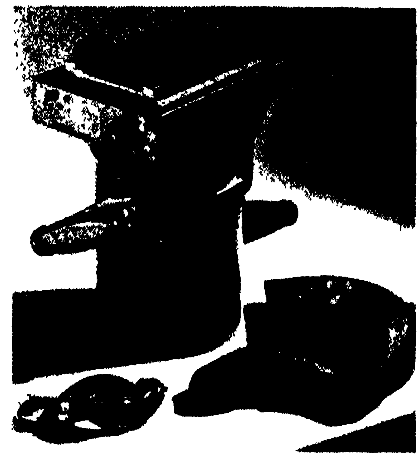
AERIAL photography may be anybody's hobby or business with the new highly efficient Cyclops aerial camera, the first high performance aerial camera ever produced for less than 200 dollars.

This rugged and dependable aerial camera has been made available by the Fairchild Aerial Camera Corporation specially for owner-pilots, non-piloting flyers, and commercial operators desiring less expensive equipment than has been available in the past. There has been a growing interest, Fairchild engineers state, in simple but efficient aerial photographic equipment

The Cyclops is so simple to operate that anyone may secure highly satisfactory results with it in connection with commercial operations or private flying. Weighing less than 15 pounds and equipped with two full-sized handles it may be handled with ease in either open cockpit or closed cabin aircraft.

The camera is fitted with an *f* 4.5, 9½-inch lens of the Tessar type, specially selected for aerial photography. It takes a four by six picture, which is the best proportion for obliques. The curtain may be opened at any time, making the rear element of the lens readily accessible for inspection and cleaning. The camera has a variable tension, focal plane shutter which is highly efficient at all speeds from 1/10 to 1/1000 second.

Filters may be installed by means of a cap which can be fitted over the rear element of the lens and in this position the filter can give unsurpassed results without danger of being blown off or becoming dusty. The maximum cross-section, exclusive of handles, measures only eight by six inches and the overall length is about 15 inches. The camera is constructed largely of aluminum. The brilliant view



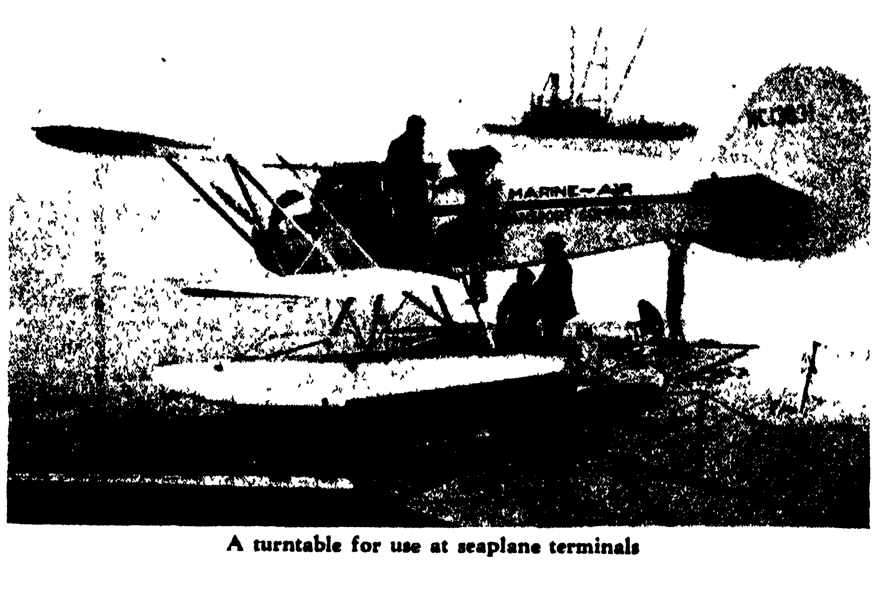
"Everyman's" aerial camera. Note the small size shown by comparison

finder folds into a recess in the cone when not in use and is prevented by a lock from folding up under wind pressure when in use. The Cyclops is suitable for close-range photographs, even time exposures on the ground, in addition to oblique aerial photographs.

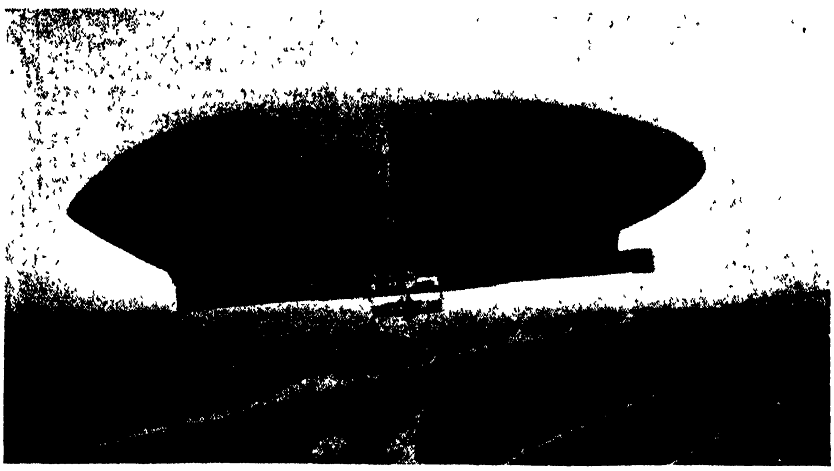
Walter Wellman, Air Pioneer, Dies

THERE recently passed away, in his New York residence, a man whose name is indelibly written in the history of aviation. Walter Wellman, who, at the age of 75, ended an eventful life of exploration and adventure, was the first man to attempt to fly across the Atlantic. Prior to that time, he had made many attempts to reach the North Pole, the last two efforts being by air. When Peary reached the coveted goal, Wellman gave up his polar aspirations and in 1910 attempted the Atlantic crossing in a dirigible 228 feet long, 52 feet in diameter, and with a lifting capacity of 12 tons.

The *America*, as the dirigible was called, embodied what were then many new and ingenious devices. It was powered with two 80 to 90 horsepower gasoline engines which gave a speed of approximately 20 to 26 miles per hour. The bottom chord of the structure of the airship was a steel tank 75 feet long, in which gasoline was carried. The most peculiar feature of the *America*,



A turntable for use at seaplane terminals



The end of the first attempt at a transatlantic flight. The *America*, commanded by Walter Wellman, disabled at sea. Note the equilibrator dragging in water

in light of present day knowledge, was the "equilibrator" which was a series of cylindrical tanks connected together by a steel cable and which was to be towed from the dirigible. The lower tanks were to float on the surface of the water and when the gas in the bag expanded and the ship tended to rise, the effective weight, increased by raising the tanks from the water, brought the ship back to normal altitude.

The transatlantic flight failed after 71½ hours in the air, during which 1008 miles were covered; both figures were records for the time.

It is with regret that we record the death of one who did so much to build up interest in aerial flight when the science was in its infancy. Glancing through the pages of Volume 103 of SCIENTIFIC AMERICAN, we find many pages devoted to the activities of Mr. Wellman. It is as though a personal friend had passed on, may his achievements always be accorded the honor they deserve.

Powerful Brakes

ONE of our photographs shows a Douglas airliner, in service with Transcontinental & Western Air, about to make a landing with its rear flaps or air brakes depressed. These air brakes have a double effect: They increase the lift capacity of the wing and hence decrease the landing speed, and they increase the drag and hence the steepness of the landing path. As a result, an airplane equipped with such air brakes can clear an obstacle at the edge of the landing field and alight much nearer the obstacle than a similar airplane unequipped with such aids to safe flying. The effect of these brakes is graphically illustrated in the diagram. Coming in over an obstacle 100 feet high the plane lands 500 feet from the obstacle with brakes. Without brakes, 1500 feet are needed.—*A. K.*

Nikola Tesla Writes:

Editor, SCIENTIFIC AMERICAN:

Engineers attach no importance whatever to static electricity generated by belt friction or otherwise. They are apt to dismiss it with the thought that the energy is infinitesimal. That is true. A little water leaking through some joint of a big low-pressure main is of no consequence, but in a pump designed for an extremely high pressure and very small delivery it is all-important. Exactly so in the electrical case. The belt or equivalent device is simply a pump capable of forcing the minute quantity of electricity produced into a condenser against a pressure and increasing the power up to the limit of working capacity of the means employed. Thus mechanical energy, in any desired amount, can be transformed into electric energy yielding direct and constant currents of many millions of volts.

Besides its value as an instrument of research, the Van de Graaff generator will be helpful in stimulating the interest in this neglected field of science and engineering which is of great promise. My comment upon it (Page 132, March, 1934, SCIENTIFIC AMERICAN—*Ed.*) was based on publications in which the device was described in its primitive form. No signal improvements were suggested or mention made of the classical methods for increasing the output. According to the latest report, the normal performance is now 20 kilowatts, from which I infer that the belts are run in a medium under pressure exceeding that of the atmosphere. This is evident since at 10 kilowatts per unit, the density of the charge on the belt, conformably to my calculations, must be about 16.66 at the spraying and 24.27 at the sucking points, which is too high for ordinary conditions. In all probability, an absolute pressure of 30 to 35 pounds per square inch is used to prevent leakage of the moving charge. This method was first resorted to by Hempel in 1885 and more thoroughly investigated by Lehmann in 1891. Other experimenters confirmed these early findings and showed that the output of a static generator is proportionate to the pressure of the gas in which it is operated.

A still better way, also known for many years, is to employ a high vacuum for the same purpose. Both of these methods have their disadvantages. Compression increases proportionately the windage loss, while the vacuum is destructive. The real limit, however, is found in the mechanical strength of the belt and even under the best conditions the performance of such a machine, considering its size, will be small although, by the employment of a Diesel drive, the efficiency might be raised to a satisfactory figure.

The generator, operating with 10,000,000 volts, will accelerate a particle, as the electron, to a speed of 3.662 $\times 10^9$ centimeters, equal to about 0.122 times that of light, but if projectiles 1800 times heavier are used, as proposed, their striking speed will be only 863 kilometers which is utterly insignificant as compared with that of the cosmic rays.

Nikola Tesla

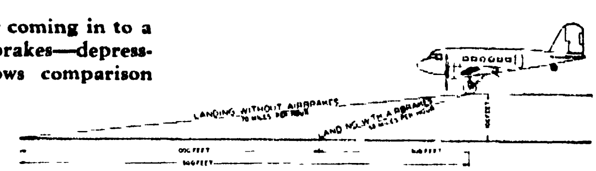
New York, February 8, 1934

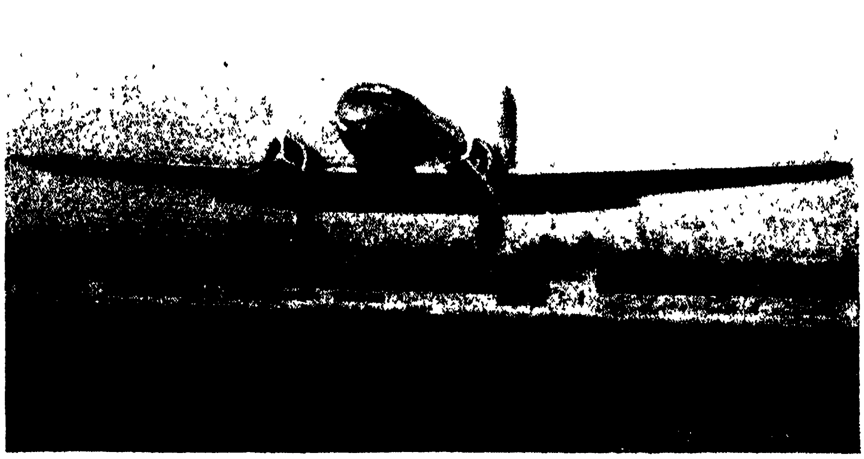
What a Twin Thinks About It

TWINS, and what they think about it, have always been subjects of considerable interest to the outsider. Dr. Alan Frank Guttmacher, a scientist who happens also to be an identical twin, devotes a considerable section of his recently-published book, "Life in the Making," to the matter. When it comes to confusion of twins, he relates an incident from his own experience that rivals the famous Mark Twain anecdote.

"I am an identical twin, and all my life my brother and I have had experiences, sometimes amusing, sometimes embarrassing, which testify to this likelihood for

***Below:* A Douglas airliner coming in to a landing with flaps—air brakes—depressed. *Right:* Diagram shows comparison between landing runs with and without the use of such air brakes**





confusion," he writes. "People are constantly mistaking us for each other; and, in fact, on rare occasions we ourselves are not sure which is which.

"As recently as a year ago, my brother and I were vacationing at a small country hotel. As we were changing into swimming clothes, I asked my brother if he thought the river would be infested with sea-nettles. I was startled by complete silence, startled because my brother was standing directly before me and still he made no answer. At length, considerably irritated, I shouted: 'Are you deaf?' To my surprise a familiar voice came from a room across the hall. 'No, what's the excitement?' I had been addressing my own form reflected in the mirror."

Unlike a case reported by Galton, in which the twins were so much alike that

their own children up to the age of five or six did not know them apart, the children of the Guttmacher twin brothers have always differentiated from the first, never mistaking the father for the uncle.

Galton also suggested that it would be interesting for twins who were closely alike to try how far dogs could distinguish them by scent.

"We have never carried out this experiment exactly, but none of the several dogs my brother and I have owned in our separate homes has ever shown any difficulty in distinguishing us. It is not, however, the same for cats, as our Persian cats seem occasionally to confuse us."

When identical twins are brought up in the same home their existences are so interlocked that they are never completely independent entities, Dr. Guttmacher reports. Each is merely half of two persons.

"In the case of my brother and myself, many memories return to attest this blending of personalities. I recall that, if one of us tore his clothes, we both had to go in and change. A casual remark made to a group of playfellows, that we had to go home and 'take our bath,' became a standing neighbourhood joke.

"Identical twins are somewhat pathetic, since until they are well grown 'my' is a non-existent word for them."—*Science Service.*

More About Aluminum Mirrors

IN the February number Professor Henry Norris Russell told how a new method had been found by which mirrors for astronomical reflecting telescopes could be made of aluminum, the metal being evaporated in a vacuum and deposited on the glass mirror disk. From the Aluminum Company of America comes, on the heels of the discovery just mentioned, another discovery of a related nature—the electrolytic brightening process which gives aluminum a reflectivity almost that of silver, coating it afterward with a protective oxide which preserves the brightness. This process was discovered by Dr. R. B. Mason, of the research laboratories of the Aluminum Company of America at New Kensington, Pennsylvania.

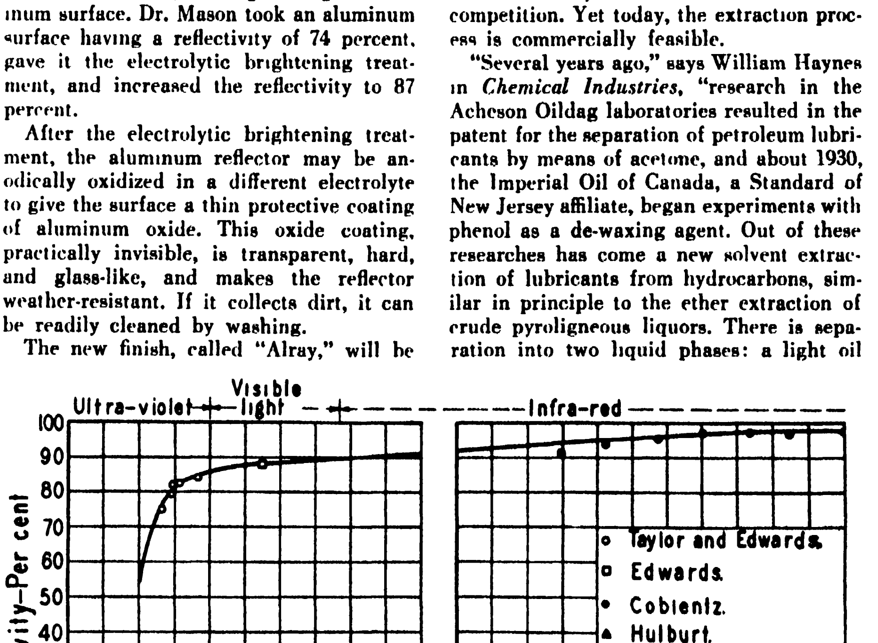
The usual reflectivity obtained with polished aluminum reflectors is about 65 to 75 percent. The electrolytic brightening

Left: **Showing the reflectivity of a new aluminum mirror.** ***Above:*** **Photomicrograph of a section of aluminum mirror; oxide at right**

process is carried out by immersing the aluminum reflector in an electrolyte of novel composition and passing direct current through the solution to the reflector, which is made the anode. Impurities in the metal surface which lower the reflectivity are dissolved out, leaving a bright aluminum surface. Dr. Mason took an aluminum surface having a reflectivity of 74 percent, gave it the electrolytic brightening treatment, and increased the reflectivity to 87 percent.

After the electrolytic brightening treatment, the aluminum reflector may be anodically oxidized in a different electrolyte to give the surface a thin protective coating of aluminum oxide. This oxide coating, practically invisible, is transparent, hard, and glass-like, and makes the reflector weather-resistant. If it collects dirt, it can be readily cleaned by washing.

The new finish, called "Alray," will be used by the General Electric Company on floodlighting equipment. According to R. T. Griebling of the Aluminum Company, this process will not prove practicable for telescope mirrors. "The electrolytic process," he states, "was developed primarily for commercial purposes and would therefore, in its present stages, be unsuitable for telescope reflectors, which insist upon a high degree of precision and accuracy not demanded in industrial uses."



Reflectivity of aluminum in the various ranges of the spectrum

Death by Fright

"THIS question has been presented to me several times," a physician writes *The Journal of the American Medical Association* (Chicago): " 'Can a man die from fright alone, without any history of actual physical injury?' "

The same journal of medicine replies: "The question was referred to an eminent authority in legal (medico-legal practice.—*Ed.*, SCIENTIFIC AMERICAN) practice. He says that in a large experience of over 40 years of actual post mortem observation abroad and in this country he has not encountered a single case of death from fright in a person of sound physical condition."

This may help cool the ardor of sundry short story writers whose heroes, and especially heroines, they now and then choose to kill off by "sudden fright."

Innovations in Oil Refining

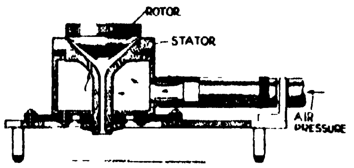
A FEW years ago, if a chemist had told a petroleum refiner that lubricating oils could be extracted by dissolving them out of the crude with suitable solvents, the practical refiner would have laughed the chemist back to his laboratory. The conventional cracking process seemed to be established beyond all chance of successful competition. Yet today, the extraction process is commercially feasible.

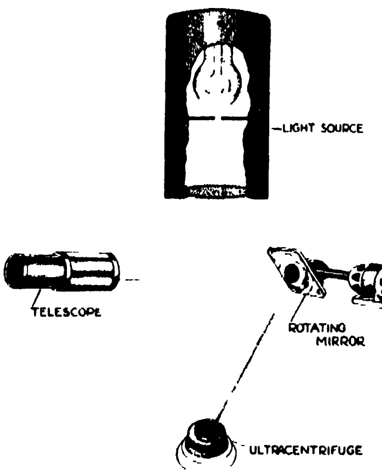
"Several years ago," says William Haynes in *Chemical Industries*, "research in the Acheson Oildag laboratories resulted in the patent for the separation of petroleum lubricants by means of acetone, and about 1930, the Imperial Oil of Canada, a Standard of New Jersey affiliate, began experiments with phenol as a de-waxing agent. Out of these researches has come a new solvent extraction of lubricants from hydrocarbons, similar in principle to the ether extraction of crude pyroligneous liquors. There is separation into two liquid phases: a light oil

similar to the Pennsylvania paraffin lubricants and a heavy Gulf base type. A wide variety of solvents have been introduced including di-chlor ether, benzol, nitrophenol, furfural, and so on, and the process has begun to assume real commercial importance."—*A. E. B.*

1,200,000 R.P.M.

A WORLD'S record for rotational speed! At the Fourteenth Exposition of Chemical Industries in New York City, considerable public interest was aroused by an exhibit, in the booth of the Sharples Specialty Company, of a centrifuge that has





been operated at a speed of 20,000 revolutions per second. This represents a maximum centrifugal force of 7,600,000 times the force of gravity, and a peripheral speed of 1390 miles per hour. It is said to be the world's fastest rotational speed for any man-made article, without qualification as to type or category.

The rotor of this ultracentrifuge, designed by Dr. J. W Beams, is of conical shape, having a maximum diameter of one centimeter. It is mounted in a cup, also of conical shape, but of slightly different angle, so that the rotor can contact the cup only at its largest diameter. The cone is grooved with a series of flutings, and apertures are provided in the cup so that compressed air or gas may be directed against these grooves at such an angle as to cause rotation.

It is obvious that speed such as this cannot be attained if there is bearing resistance, and the unique feature of the centrifuge is that the rotor rides entirely on a bearing of gas. The air that is used to cause rotation escapes between the cone and the cup at high velocity and floats the rotor entirely free of any mechanical contact, yet there is an apparent suction that holds the rotor from coming entirely out of the cup even though the entire machine should be inverted. (See page 234, April, 1932, SCIENTIFIC AMERICAN, for a complete description of an earlier ultracentrifuge which operates on the same principle.—*Ed.*)

The maximum speed so far attained has been developed by the use of hydrogen as a propelling medium, delivered at 160 pounds per square inch. The advantage of hydrogen over air is, first, the velocity of the hydrogen molecule is about three and a half times that of air, and second, hydrogen has about one half the co-efficient of viscosity, which reduces gas friction. The maximum speed attained with air at 140 pounds per square inch was 12,000 revolutions per second.

The most satisfactory method of measuring the speed of the rotor is as follows:

A white spot is painted on the top face of the rotor at a point eccentric to the axis. A light is focused on this spot. A mirror is located in a position where it can reflect the image of the white spot into a telescope placed horizontally. The mirror is rotated at a fixed speed. The rotation of the mirror makes each recurring image of the spot appear at a different point in the telescope field, and the speed of the rotor can be accurately determined by measuring the distance between two successive images of the spot, finding what arc of the mirror rotation this distance represents, and computing the unknown speed of the rotor from the known speed of the mirror. A graphic illustration of the amount of centrifugal force generated is the fact that frequently the paint spot will be thrown off before the rotor reaches full speed.

Eggs from Discontented Hens

CAKE bakers use frozen eggs by the carload, very good eggs, too, which were broken when fresh and frozen for mass production of bakery goods, to save time and get uniform quality.

But a Los Angeles cake bakery got some bad frozen eggs on a yearly contract, and called in Arthur R. Maas, consulting chemist, to locate the trouble. Mr. Maas, reporting the incident in his little house-organ *Chemistry and You*, says: "We took samples of the eggs—whites separate, yolks separate, and whites and yolks together. We baked cake with each kind, and with fresh eggs bought in the market. Cake made with the contract eggs was not light and had a bad flavor.

"Analysis of the eggs showed that they were deficient in protein, and in fat, and had excess moisture. This led to an investigation of the diet fed the hens that laid the eggs, and there we located the difficulty.

"Times have been bad, too, for the little red hen. Her product has not brought a price that covered her feeding costs, and so her boss, the poultry-man, has been tempted to cut down her rations, and while she has gone right on laying, the eggs have lacked the quality necessary for good cake. Even cake made in a big commercial bakery must have eggs from contented hens, and the little red hen that laid these eggs was not contented, and so a claim for inferior quality had to be met, and the little red hen lost a good contract."—*A. E. B.*

Left, above: **A cross-section of the stator of the new ultracentrifuge described here, showing how air is supplied to the underside of the rotor.** ***Left:*** **How the speed of the ultracentrifuge is measured.** ***Right:*** **Photo of the device. One of the rotors is balanced on the finger at extreme right**

How Loud Is "Half As Loud"?

APPARENTLY the human ear refuses to abide by rules of mathematics when it judges for itself how much louder or quieter one sound is than another, so experiments in the University of Michigan physics laboratories indicate.

Averaging the judgments of a group of student observers as to what volume of sound was "half as loud" as another sound, this half-way point as determined by the ear was found to be only one tenth of the power of the original sound rather than one half. A listener at a certain distance from a sound source must move to more than three times as far away to have the loudness fall to one half value, Dr P. H. Geiger, research physicist for the University Department of Engineering Research, and Prof. F. A. Firestone, found.

Using the "decibel," the unit which science has adopted in recent years as a standard quantity of sound, it was found that for ordinary sounds the ear judged a sound "half as loud," when the level of sound had dropped by 8 to 10 of these units. This was not half of the total decibels of original sound, the workers found. For example, a sound of 50 decibels is half as loud to the ear as a 60 decibel sound. Fractions of loudness down to one hundredth and multiples up to 100 times were measured, with similarly unexpected results.

These experiments show that loudness, as heard by the human ear is not directly proportional to any of the physical characteristics of sound. Physical measurements taken together with information on how the ear acts, make it possible to compute the loudness of a sound as the ear hears it. The Michigan experiments, taken together with data from the Bell Telephone Laboratories on other aspects of hearing, indicate that the sensation of half loudness means that half as many nerve impulses reach the brain in a given time.

The Intelligence Rating Myth

A MODERN myth that has received wide acceptance is exploded by Dr. David Segel in *School Life*, official monthly journal of the Federal Office of Education.

This myth, arising from certain tests made of men drafted for the United States

Army during the World War, asserted that the average intelligence of adult Americans was that of 12-year-old children.

"That assertion is not true," declares Dr. Segel, expert on educational tests and measurements in the Office of Education. "Only 5 percent of our adult population have a mental age of 12 years or less.

"The statement that the intelligence of the adults of this country was about that of 12-year-olds came about through a misinterpretation of the data obtained from the intelligence testing carried out in the Army during the World War," he points out. "There are several factors at work which brought about this misinterpretation. The mental ages obtained on the intelligence tests used in the Army were based on equivalent mental ages found on the individual Binet intelligence test. This Binet test, however, underrates adult intelligence.

"Later researches have shown positively that the intelligence of adults of this country will average considerably above that of 12-year-olds."

By using research studies of typical cross-sections of American society, Doctor Segel found that intelligence, which is defined as the *growth and decline of the ability to learn* "rises rather sharply until about the age of 15 or 16, then rises less and less sharply until about the age of 22 or 23. From this age the curve begins to drop, at first very slowly, and then more and more precipitously. The mental age of the adults of the early twenties (20-25) is therefore above that of any age group in the teens. At no chronological age level does the *average mental age* obtained from investigations fall to that of 12-year-olds."

Applying the findings of research with typical cross-sections of American citizenry to census figures for the number of persons in the age groups between 16 and 50 years of age, Doctor Segel finds that the "average mental age of men and women of this country according to this method of calculation is 17.7.

"The word 'intelligence,'" points out the Office of Education expert, "is very loosely used. To the scientist it does not mean the total, collective knowledge, experience and judgment of an individual. It means, in other words, the speed of mental reaction to a new situation—his capacity to grow mentally."

Inks for Marking Porcelain

COLORED markings on porcelain, quite permanent in character, are made with a special "ink" developed by L. Kebrick, who describes his method in the *Chemical Analyst*. Mr. Kebrick uses his method for marking porcelain vessels in the laboratory. Presumably, however, his formula is equally suitable for any porcelain surface which may be heated to bring out the color. The formula suggested comprises:

Sodium carbonate—1 part.
Crystalline sodium borate—2 parts.
Potassium chromate—3 parts.
Water—40 parts.

The marking is made on the clean porcelain surface and held near a Bunsen flame to evaporate the water, after which it is strongly heated in an oxidizing flame to develop the green color of the chromium compound. In this way a vessel may be marked in about one minute, since ordinarily sufficient solution runs from the pen

Henry Ford, left, and Edsel Ford, right, with Rufus C. Dawes, president of the World's Fair, examine a scale model of the Ford building to be erected in 1934

to impart a suitable depth of color to the characters. When a blast lamp is employed, the markings are greenish black, probably due to the formation of a chromium silicate.—*A. E. B.*

An All-Wave De Luxe Radio Receiver

WITH American and foreign stations operating on more or less consistent schedules on short waves, and with amateur conversations, police calls, and transoceanic telephony on wavelengths below the regular broadcast band, the demand is rapidly increasing for a really high-grade radio receiver capable of receiving all of these transmissions without the necessity of making troublesome changes.

One set that fills these requirements is the Scott all-wave superheterodyne illustrated in these columns. In this receiver, which incidentally is guaranteed for five years, there are to be found many up-to-date features that insure the best possible reception under all conditions. The wavelength bands are selected by means of a switch located on the front panel, turning of which throws into the circuit the required set of coils. The user does not have to change plug-in coils, as all the inductances are within the chassis and are controlled by the switch.

The set covers wave bands from 15 to 550 meters with one knob operating one dial. No trimmer condensers or other balancing devices are used. The audio amplifier is designed to give practically undistorted or lineal output at any amplification. An automatic volume control, which functions in about 1/20th of a second, preserves the sound level regardless of variations in the strength of received signals. A specially designed low-pass filter circuit in the audio amplifier makes possible a great reduction in static interference, a highly desirable feature in distance reception.

Ford at the World's Fair

PLANS for a giant Ford exposition at the 1934 Chicago World's Fair were disclosed recently by Henry Ford to Rufus C. Dawes, president of A Century of Progress International Exposition.

The Ford exposition, which will be housed in a magnificent building in the heart of the fair grounds, will portray to the millions of exposition visitors the contributions which the industries, arts, and sciences make to the motor-car industry. The Ford exposition building will be 860 feet long and will be located in an 11-acre plot fronting on Lake Michigan and bisected by Leif Ericson drive, the main fair boulevard.

"The scope of the Ford plans for the exposition is magnificent," said Mr. Dawes. "I am very enthusiastic over the project and am confident that it will mean a major contribution to the success of the 1934 fair."

"We want our exposition to be just as instructive as it is possible to make it," Mr. Ford told Mr. Dawes. "Wherever possible each exhibit will be in action, producing something. We want the exposition to be a moving demonstration of the contribution made by the various industries, arts, and crafts to the modern automobile."

"Creep" in Rocks is Like "Creep" in Steel

THE age of mountains may be determined from the "creep" of its rock formation, as a result of studies now being conducted on the stretch or "creep" of steel, scientists attending the Society of Rheology convention at Pittsburgh, Pennsylvania, were recently told by Dr. A. Nadai, research physicist of the Westinghouse Electric and Manufacturing Company.

Mountains rise out of plains and islands rise from ocean bottoms as a result of the slow flow or movement of rock, a phenomenon common to all viscous or plastic materials, he explained. Of far greater immediate importance is the similar flow of steel which is used in present day machinery.

This flow or "creep" is surprisingly similar in rock and metal. Even the formula which fits the "creep" movement is almost alike for both materials. Discoveries in the field of metals may interpret parallel behavior in rock behavior and vice versa.

The time element is the important difference in the two problems. Geologists are interested in rock "creep" that takes place over millions of years; physicists in the "creep" of steel only for the usual life of machinery—10 or 20 years.

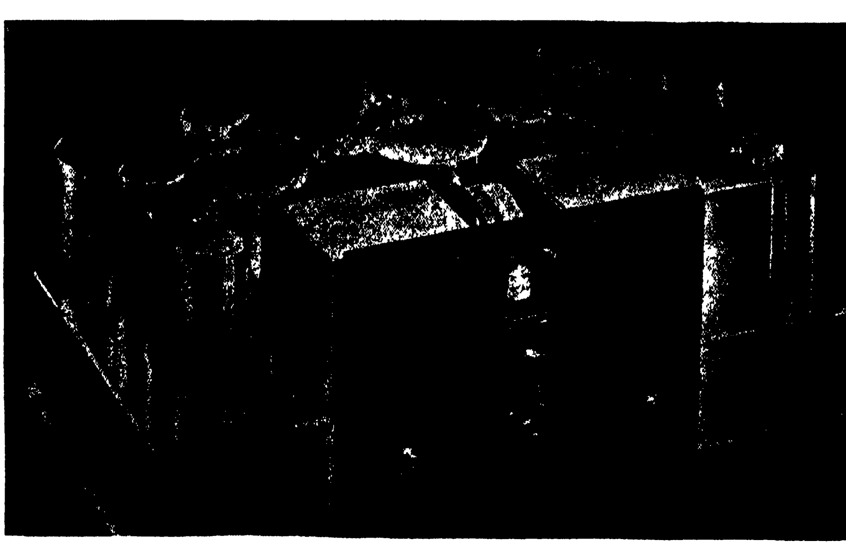
Research into the physical laws governing metal's "creep" has become necessary because engineers are ever designing larger and more efficient machines such as large steam turbines, with the result that the metal in the machines is called upon to work at higher temperatures, at higher pressures, at faster speeds and with smaller clearances between adjacent parts.

This evolution to more efficient machines and more exacting requirements of metals comprising them is particularly evident among manufacturers of steam turbines and steam boilers, and of cracking stills used in oil refineries.

Unfortunately, ordinary metals "can't take it." Metal, when subjected to high temperature and a steady pull tends to stretch or "creep" in the direction of the pull.

For example, the metal blades of a steam turbine motor are continually stretching, although only an infinitesimal amount, while they are being whirled around at the rate of 3600 revolutions per minute in superheated steam.

Clearance of 1/1000th of an inch is permitted in these high speed turbines. If the blades stretch more than the allotted clearance, they will rub the outer casing, generate terrific heat and probably explode the turbine, endangering lives and damaging property. Hence the importance of know-



Chassis of the all-wave radio receiver described on this page

ing how much the metal blades will stretch or "creep."

The solution to the problem lies with the metallurgist and physicist. The metallurgist must find a metal that will "stand the gaff" and the physicist must devise a method of predicting accurately how much the metal will "creep" when in service under a given set of conditions for 10, 20, or 30 years.

The method developed must be accurate and reasonably rapid to be of any value. If the method is too slow it will be used but rarely, but if rapid it will likely be used in everyday tests. Engineers look forward to the time when 15 minutes will be considered "reasonably rapid."

Dr. Nadai pointed out the difficulty which faces a physicist who attempts to predict in a short test the infinitesimal "creep" of metals. Steel that will creep 1/1000th of an inch in 10 years will creep approximately

0.0001	Inch	in 1 year
0.00001	"	in 1 month
0.0000003	"	in 1 day
0.00000001	"	in 1 hour
0.000000003	"	in 15 minutes

This means that, in order to predict by means of a 15-minute test, "creep" in steel at a rate of 1/1000th of an inch in 10 years it is necessary for the physicist to develop apparatus which can distinguish the stretch of three billionths of an inch in a one-inch sample of the steel.

Westinghouse research engineers have developed analytical methods and apparatus which reduce the duration of "creep" tests from three months to one month. New methods and apparatus now being developed may reduce the duration of "creep" tests to only one hour.

Cheap Source of Vitamin C

JUICE from the lowly turnip is recommended as a good substitute for orange juice or tomato juice. Attention is called to its value as a cheap source of scurvy-preventing vitamin C by Dr. E. W. McHenry of the University of Toronto School of Hygiene in a report to the *Canadian Medical Association Journal.*

In Toronto, one cent will buy 1100 vitamin-C units from turnip juice, whereas the number of vitamin-C units from one cent's worth of lemon juice are 180, from orange juice 220, from tomato purchased as juice 170 and from tomato juice prepared from canned tomatoes 180.

Two pounds of ordinary turnips will give 15 ounces of the juice, which is said to be sweet and not unpalatable. Salt improves the flavor, but for infants the pure juice is advised. The juice may be easily made at home by grating a section of turnip and pressing the juice from the minced material in a linen or other cloth.—*Science Service.*

Some Geographical Oddities

GEOGRAPHICAL facts which are quite contrary to established notions are brought to light by a careful examination of the map. Relative locations of certain points are often found to be quite different from the general impression concerning them. This is pointed out by the Touring Bureau of the California State Automobile

(*Please turn to page* 215)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

MACHINES for grinding and polishing the concave mirror disks which form the most important part of the reflecting type of telescope are not a necessity, as has been explained in the book "Amateur Telescope Making," and perhaps 95 percent of the mirrors made are done by hand, but it is fun to make a machine which will do this work and again it is fun to watch the wheels go 'round. This month we show

Hely's machine

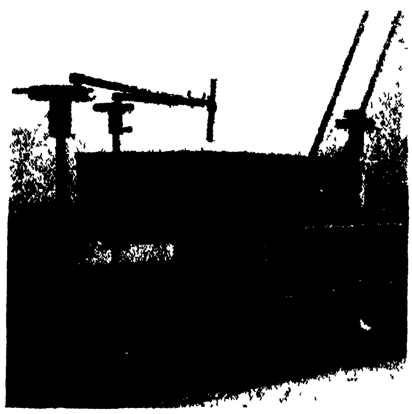
several such machines built by amateur telescope makers, also one or two used by professionals.

The first is the Lee machine (page 148, "A.T.M."), made by L. St. John Hely, M.D., 912 Macdonald Ave., Richmond, California. The reciprocating rod which leaves the picture at the right hooks up to a reducing gear with single belt drive and the ¼ horsepower motor of a band-saw outfit. Dr. Hely finds this machine excellent and says anyone can make it who is "enough of a mechanical genius to open a can of oysters."

Leo J. Scanlon of the Astronomical Section of the Academy of Science and Art of Pittsburgh (address Valley View Observatory, 106 Van Buren Street, Observatory P. O., Pittsburgh, Pa.) writes: "I send a picture of a grinding and polishing machine built by Robert H. Marshall, member of our gang Marshall would sooner spend a week building a machine than a few hours polishing a glass. His address is 120 Maywood Street. The machine is powered with a ¼ horsepower washing-machine motor, on the shaft of which is a worm gear, driving a 20-tooth worm gear, which reduces the speed of the vertical drive shaft to approximately 80 r p m. The table is driven at the rate of about 8 r.p.m.

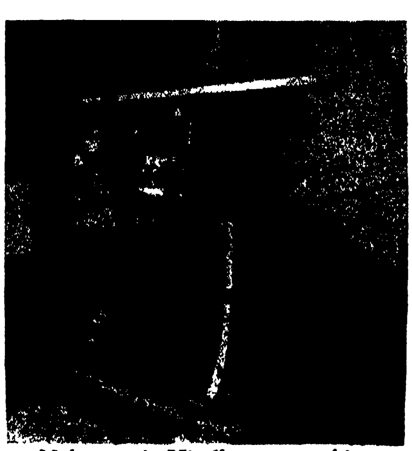
"The grinding arm makes anywhere from 50 to 100 strokes per minute, and is usually run about 80 per minute on a 6-inch glass. The length of stroke can be varied between one and four inches, by suitably inserting a pin in an eccentric arm at the head of the drive shaft. The tool can be made to ride center over center, or can be varied to ride any intermediate zone between center and edge, by adjusting a pin in the bar in the foreground of the picture.

"The grinding or polishing tool is made to rotate either with the mirror or against it, and at various speeds depending upon the surface to be worked. Here's a point that is not generally known," Scanlon continues. "If you revolve the tool with the mirror you deepen the center; if contrary, you cut down the edges. This knowledge is handy in polishing, especially when the mirror doesn't want to clean up around the edges. Parabolizing can be attempted by suitably arranging the cutting speed of the tool by rotating it with the mirror. The tool usually makes 10 to 20 revolutions per minute. Capacity of machine, 12-inch mirror."



Nakamura's 30-inch machine

Nakamura's 10-inch reflector



Nakamura's Hindle-type machine

DR. K. NAKAMURA of Kwasan Observatory, Yamashina, Kyoto, Japan, writes: "Two photographs are enclosed. One is the view of a large grinding and polishing machine of personal design at my optical workshop in the basement room of the Kwasan Observatory. The machine can polish 30-inch mirror easily. The other is the photograph of 10-inch, *f*/3.8 photographic reflector belong to Mr. Shibata. The guiding telescope is the four-inch reflector. The optical parts were made by me and the mechanical parts by Nishimura works. The 17th magnitude stars are easily photographed with one hour exposure." Dr. Nakamura sent three photographs, not two as he wrote, the third being that of a machine for grinding mirrors up to 12-inch diameter. There is a lot of amateur telescope-making activity in Japan. We have seen their instruction book but not read it!

J. W. Fecker, professional optician, 2106 Perrysville Avenue, Pittsburgh, Pa., has given us a photograph of a large machine, which is reproduced on the opposite page. This is the type shown in "A.T.M.," page 151, Figure 3, at *C*, but very much larger. Mr. Fecker states that this machine is used by him for giving a first polish to large surfaces, and that he uses other means for final polishing and figuring.

Edwin P. Martz, Jr., 726 North Elmwood Avenue, Oak Park, Illinois, sends a photograph of his own machine, which is of the same type as the one just mentioned. Martz has three telescopes and is making a special study of Venus, using filters for improving definition.

AMATEUR telescope making and astronomical activities reported are as follows: The Amateur Telescope Makers of Dayton (Ohio) have elected Mr. Loren Shumaker of 1608 Wyoming Street, Dayton, secretary of their organization, which has 25 members. Mr. Shumaker has worked out a method of making the Ronchi test quantitative. Dr. J. A. Anderson of the Mount Wilson Observatory has independently

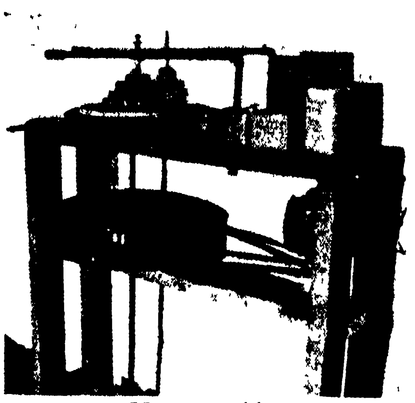
Marshall's machine

worked out a similar method, and Mr. Franklin B. Wright, 155 Bret Harte Road, Berkeley, California, Chairman of the East-bay Astronomical Association and co-author of "A.T.M." (pages 257-261), is said to have worked out something similar.

An astronomical society has been organized in New Orleans. Mr. Harry L. Lawton, 215 Stella Street, that city, is president.

The Westinghouse Club at Wilkensburg,

Fecker's pre-polisher



Martz' machine

Pa., has discovered an interest in telescope making and microscopy and has an Optics Section devoted to these hobbies, according to Mr. Fred C. Wilharm, Box 63, Homewood Station, Pittsburgh.

SOME years ago the price of a six-inch mirror made by Zeiss was 150 dollars. Dealers who started in business after the telescope-making hobby was developed among our readers cut this price to about 50 dollars. Partly this was justified by the facts but partly, it is thought, this resulted from a feeling that a maker who was only recently an amateur ought not to charge as much as a professional. Nevertheless many amateurs can do work fully as good as professional work, and better than some that had been sold previously.

More recently all sorts of cheap mirrors have been offered. If you have made mirrors yourself you know that no one can afford to make good mirrors at very low prices. If you have not, be warned and do not take the lowest bid.

Recently a reader wrote us that his eight-inch mirror, refigured by a dealer, would not resolve detail resolved by a six-inch refractor which he had used. We asked him to send it to us. On test the difference in radius of inside and outside zones proved to be a half inch! (f/10 mirror). The dealer had called this mirror paraboloidal. It was not paraboloidal, nor was its curve even a conic section. If your purchased or refigured mirror seems suspicious we should like to hear from you.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

EMULSIONS, WAXES, RESINS AND COSMETIC FORMULAE, give information on the latest methods of making these products. The two pamphlets are sold as one by the *Glyco Products, Inc., Bush Terminal Building, No. 5, Brooklyn, N. Y. The two for ten cents.*

SLUM CLEARANCE AND KNICKERBOCKER VILLAGE is from an address by Fred F. French and describes what is to be done in one of the worst slums in New York. What has been done in Tudor City at the easterly end of 42nd Street is almost a matter of history. In a nut shell, the idea in both developments is to walk to business and thus cut hours of traveling time. *The Fred F. French Company, New York City.—Gratis.*

HOW TO KNOW THE MUSHROOMS AND TOADSTOOLS is a brief circular prepared by Professor F. C. Stewart, mushroom specialist at the Experiment Station at Geneva, N. Y. Every season newspapers chronicle instances of persons made ill by eating wild mushrooms, sometimes with serious consequences, with the result that the public becomes alarmed and large quantities of an excellent food go to waste at our very doors. The circular may be obtained from *New York State Agricultural Experiment Station, Geneva, N. Y.—Gratis.*

BAKERY MACHINERY LUBRICATION (*Lubrication*, Vol. XIX, No. 8, August, 1933). Efficient operation of baking machinery and the manufacture of quality products depends to a marked degree upon the manner of lubrication and the prevention of contamination of materials. This pamphlet describes the best lubricating methods. *The Texas Company, 135 East 42nd Street, New York City.—Gratis.*

AERONAUTICAL RESEARCH COMMITTEE REPORT FOR THE YEAR 1932-1933 gives data as to stability and control of airplanes, spinning, aerodynamics, and so on. Special attention is given to airplane noise. *His Majesty's Stationary Office, Adastrol House, Kingsway, London, W. C. 2, England - Two shillings, postage extra.*

PULVERIZED FUEL 1932-1933 (Publication No. A 6). This report includes installation and operating data from 43 companies covering 181 boiler units. *Edison Electric Institute, 420 Lexington Avenue, New York City— 75 cents to members and their employes.—$1.85 to non-members.*

THE STREAM OF EXPERIENCE—commemorating the 25th anniversary of the Fuel Engineering Company of New York—describes a system of testing fuels; in six years 25,000 samples have been tested and the records classified. The pamphlet describes how fuel-engineering began and what it is now doing for other industrial corporations. The fuel valuegraph is a chart to compare the cost of steam, or the values of fuels at the same or different efficiencies. A pad of the blanks costs $1.00. *Fuel Engineering Company of New York, 116 East 18th Street, New York City.*

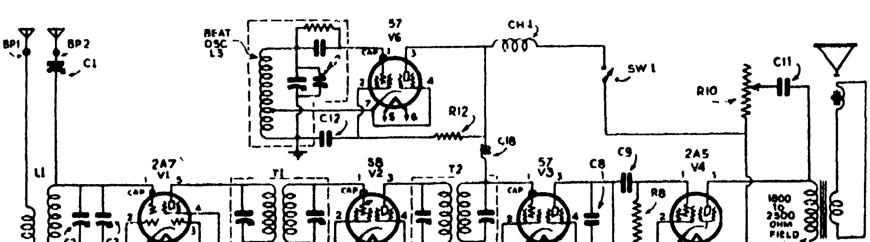
THE AMERICAN RAILROAD IN LABORATORY is a brief digest of research and experimentation conducted by railroads individually and collectively through the American Railway Association in the interest of constant improvement of their facilities and service. 544 pages. *American Railway Association, Washington, D. C.—50 cents.*

SUN SPOTS AND WEATHER (Smithsonian Miscellaneous Collections, Volume 87, No. 18), by C. G. Abbot. Sun spots are associated with important modifications of weathers not hitherto recognized, says Dr Abbot. *Smithsonian Institution, Washington, D. C.—5 cents (coin).*

KOHLER VILLAGE is a town-planned Wisconsin industrial community which created a great deal of interest when the Kohler Company removed a manufacturing enterprise from a city into the open country. A study of the garden cities of Europe showed that some of them are far ahead of the best of our industrial towns. Eventually, homes built by the people themselves materialized and what was a vision has become a reality, and is justifying itself both esthetically and in the practical business of living. *The Kohler Company, Kohler, Wisc.—Gratis.*

ST. CATHARINE'S, ONTARIO, AND THE WELLAND SHIP CANAL. St Catharine's is called Canada's Garden City; it is fully illustrated and described in this pamphlet. It is a weird sight to see a large ship passing through the town. Interested parties can obtain a copy by addressing *Herbert H. Smith, City Clerk, St. Catharine's, Ontario, Canada.—Gratis.*

HARD-FACING WITH HAYNES STELLITE PRODUCTS describes the economies that have been introduced in hundreds of cases by the application of hard-facing materials to wearing surfaces. Where abrasion is intensified by heat, hard-facing proves to be doubly valuable. Hard-facing permits the utilization of cheaper base metals for wearing parts. The many applications are described in this 96 page booklet. *Haynes Stellite Company, Kokomo, Indiana.—Gratis.*



THE SUPREME SIX SHORT-WAVE SUPER. In this de luxe short-wave receiver, designed for the radio connoisseur, a type 2A7 Lafayette tube performs the double duty of first detector and oscillator. In the intermediate frequency amplifier is a type 58 tube. The beat oscillator is a 57, the second detector another 57, the power output tube a 2A5, and the rectifier an 80. This receiver uses the new air-tuned Hammarlund intermediate frequency transformer and Alden plug-in coils. The beat-frequency oscillator gives excellent selectivity for the reception of continuous-wave transmissions. A Trutest power transformer supplies all necessary voltages. Drawings of this set, a complete list of parts, and other data may be obtained from the *Allied Engineering Institute, 98 Park Place, New York, N. Y.—10 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 211*)

Association, which is called upon to answer requests from motorists for a wide variety of information. For example:

Reno, Nevada, is 100 miles farther west than Los Angeles, and Jacksonville, Florida, is farther west than Cleveland, Ohio.

The westernmost point of Alaska is farther west of San Francisco than New York is east.

In going from Detroit to Canada the traveler moves southward.

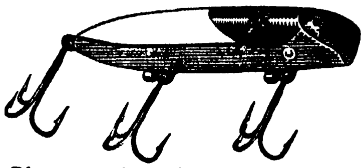
New York lies to the west of some cities on the Pacific Coast of South America.

Santa Barbara, by reason of its location, sees the sun both rise and set in the Pacific.

Through the Panama Canal from the Pacific to the Atlantic the direction traveled is not east, but northwest; from the Atlantic to the Pacific, not west, but southeast.

A Better Bass Bait

PLUG casting for bass and other game fish is many years old, and the available plugs take many forms. Recently, however, there has appeared on the market a plug that is so designed as to be worthy of special notice. This bait, a product of the South Bend Bait Company, follows the general lines of a time tested lure, but is so mechanically improved as to constitute a radical departure from the usual construction methods.



Phantom view of the bass bait described, showing aluminum plate

The one outstanding feature of this plug is an aluminum plate that extends the length of the body and serves as a keel as well as making a direct connection between the hooks and the line. The plate is riveted and cemented to the wood body, and several coats of paint and lacquer make a continuous waterproof unit of the plug. Four eyes in the plate provide for the attachment of the line and three sets of hooks which are readily detachable.

27 Billion 'Phone Calls in U. S. Yearly

TELEPHONE statisticians have completed a survey of the use of telephone and telegraph facilities throughout the world. The survey covers the year 1931, the latest period for which comparable figures are available.

This study shows that, next to the United States, the country where the greatest number of telephone conversations take place is Japan. Canada holds third place, Germany fourth, and Great Britain and Northern Ireland fifth. The figures give 27,500,000,000 telephone conversations during 1931

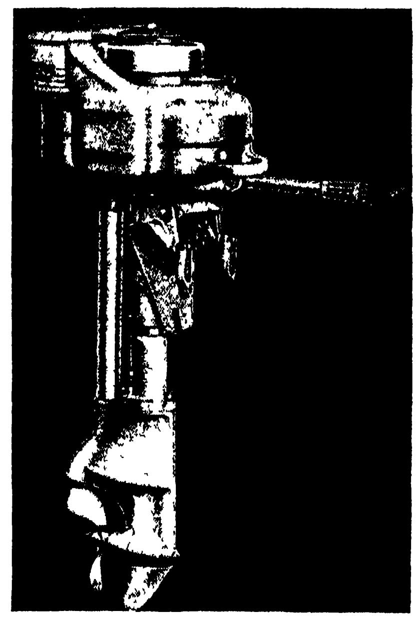
for the United States, 3,326,148,000 for Japan, 2,565,641,000 for Canada, 2,376,000,000 for Germany, and 1,590,000,000 for Great Britain and Northern Ireland.

Next come France and Sweden, with 847,206,000 and 842,000,000 telephone conversations respectively. They are followed by Poland, Spain, Denmark, Austria and The Netherlands.

Telephone conversations in the United States average 222 per capita. On a per capita basis, Canada outranks the United States in telephone conversations, and New Zealand is in third place, with Denmark and Sweden following.

Outboard Motor Improvements

"HOODED Power" is the term applied to the design of a new outboard motor in which the power head is enclosed in an aluminum housing that completely protects carbureter, wiring, and spark plugs from the weather, as well as guarding



"Hooded Power" in an outboard

against rough handling. Only two controls and a primer button project outside the housing.

Two entirely new models in both the Evinrude and Elto lines for 1934 present this improvement in outboard appearance and operating satisfaction. One is a 42-pound twin-cylinder motor developing 5½ N.O.A. certified brake horsepower at 4000 revolutions per minute. The other is a new four-cylinder model weighing only 55 pounds and developing 9.2 N.O.A. certified brake horsepower at 4000 revolutions per minute—the most portable four-cylinder outboard motor ever built.

Also in the Elto and Evinrude lines is an all-electric model weighing 60 pounds and capable of speeds up to four miles an hour. On lagoon boats, children's play boats and dinghies this model finds much favor, for silent power is at one's command by merely throwing a switch.

Peace By Starvation

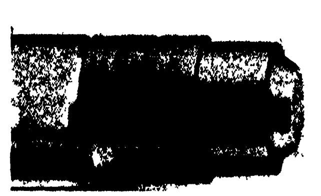
AN English writer was recently discussing the economic boycott as a peaceful substitute for war in the settlement of international differences. He concluded that

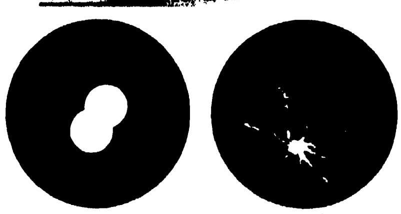
the economic boycott in the long run is simply "peace by starvation" which quite rightly it is. The question logically arises then, where is the great humaneness of the boycott? If by boycott a group is starved to submission or death there is not a great deal of sense in substituting lack of food in place of preponderance of machine guns, bombs, or artillery fire. In the final analysis both methods produce the same result. Which then is the more humane method?

Peace by starvation versus peace by open or closed warfare, any way you look at it, doesn't seem to have much to debate about because both horns of the dilemma are the infliction of physical suffering. Both will do that and both stand a likely chance of achieving the same end. The boys and girls who press for the boycott, however, paint in rosy hues. They say the economic boycott will take the barbarism out of war; that it will accomplish by moral suasion what mankind has tried to do only by physical force. For ourselves we cannot escape a homely example. If a gangster is about to assert himself along unfriendly lines, starvation may be tried, of course, but a rifle or an automatic will put the thug where he belongs much more quickly. If time is of no immediate concern the boycotting or starvation process can be tried. But whether this desperado is subdued by the pangs of hunger or by a few well placed shots, physical force of one kind or the other does the job. And nothing else will do it but physical force. The comical part about the theory of the boycott preachers is that when you starve a man or a group of men you are humane but when you don't starve them but make them come to terms by other kinds of force, then the thing is brutal, terrible and hellish!—*Army Ordnance.*

.22 Long-Rifle Sharp Shoulder Target Ammunition

FOR several years, there has been a need among small bore target shooters for a type of cartridge that would punch a clean





Top: **Enlarged view of .22 sharp-shoulder bullet.** ***Lower left:*** **Clean holes made by new bullet, and** ***right,*** **jagged tears made by old style**

hole in the target to facilitate spotting and scoring.

At first glance the solution of this problem would appear to be reasonably simple, and amateur attempts were made by certain enthusiasts by the simple process of cutting off the nose of the bullet. These crude attempts of course were not conducive to good target accuracy, but they illustrated the principle desired. This prac-

tice furthermore reduced the weight of the bullet and consequently increased the muzzle velocity.

Actual design for production of the sharp shoulder type of .22 long rifle bullet presented many difficulties, in order to obtain absolute uniformity of shape and the desired degree of stability in flight. The sharp-shoulder bullet, as perfected by the Remington Arms Co., Inc., makes a perfect, round hole, which gives the effect of having been cut out of the target with a paper punch. This is in striking contrast to the jagged holes made by the ordinary bullet. The clean-cut holes made by the new bullet make more accurate spotting and scoring. The bullet has a nose that is practically flat instead of conical. Friction, caused by the contact of a bullet with the rifling of a rifle or pistol barrel, is diminished in the sharp-shoulder bullet by reducing the diameter of part of its length. The portion that takes the rifling, however, is sufficiently long to form a tight seal for the gas generated by the burning of the powder and thereby take full advantage of the propellant force. The bullet is lead lubricated and weighs 40 grains.

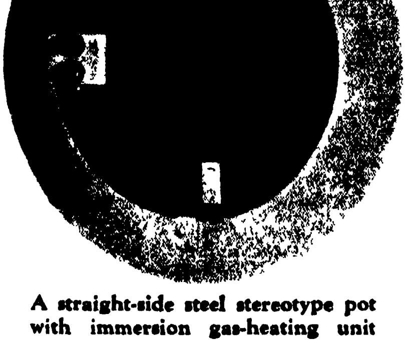
Despite the fact that the nose of the new bullet is practically flat and, therefore, sets up a greater wind resistance than the conical type, the sharp-shoulder bullet has more velocity. The bullet has an average speed of 1275 feet per second, while that of the old type is 1075 feet per second.

Immersion Melting With Gas

TODAY most users of soft metals in industrial operations realize that the mere application of heat is but one of the factors to be considered. A very definite demand now exists among progressive organizations for heating equipment which will control temperature, rate of heating, dross formation, and fuel consumption.

The C. M. Kemp Manufacturing Company has developed equipment which meets this demand. They have provided what are known as immersion melting units, the use of which gives controlled heating of any metal bath which must be maintained in a molten condition at temperatures not in excess of 1800 degrees, Fahrenheit. Certain specific applications, such as galvanizing, have not been advocated due to the lack of knowledge of a material that would withstand the dissolving action always present.

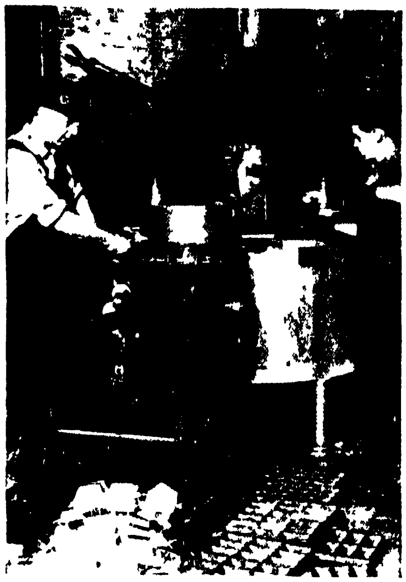
Regardless of the apparatus for which it



A straight-side steel stereotype pot with immersion gas-heating unit

is used or the temperature of the bath, the construction of the Kemp immersion melting element is always substantially the same. It consists essentially of a large tubular flue in the form of a re-circulating rectangle through which a gas flame is blown. This tubular flue is immersed in the bath of molten metal. Temperature control is maintained by control of the air and gas ratio, the requisite amount of heating surface having been carefully calculated for the specific job at hand.

Inasmuch as the immersion element



Controlled heating of metal pots may be had with the unit described

serves the purpose of a heat transfer medium only, and not that of a supporting container, the cross section is but a fraction of that usually encountered. Economies in operation are assured because of the reduction in radiation losses. This is due to the fact that the heating element is within the metal rather than in a combustion chamber surrounding the pot, as in external heating. With immersion heating there is virtually no stored heat, for that usually present in over heated brick work and container is eliminated.

It is claimed that with the Kemp unit there is a lower initial and installation cost due to the elimination of expensive brick work and settings, the use of lighter pots or containers, and the use of smaller pots because of the unusually high heat rate.

Kovar

MUCH of the work of a research engineer can pass almost unnoticed even by those who use the product of his study. For instance, a large water-cooled electronic tube is an interesting device as a whole but a piece of metal forming part of the wall would attract little attention. Yet for certain tubes an alloy of new properties is needed and the tube would be impossible without it.

The alloy Kovar is new and has certain specific properties making it suitable for use as a cooling wall in large mercury-pool tubes. It has a thermal expansion which permits permanent sealing to glass. Copper has been successfully used in this place but when mercury is introduced into the tube the copper amalgamates and its strength is

quickly lost. Kovar meets all the usual requirements and is, in addition, unaffected by the mercury or mercury vapor.—*A. E. B.*

Automobile Elevator for Monster French Ship

A SPECIAL automobile elevator, the largest and most unusual ever projected for ship use, is being built by Otis-Pifre in Paris for the new French liner *Normandie*, the 72,000-ton ship that will go into service in 1935, it was announced by the International Division of the Otis Elevator Company.

With a lifting capacity of 11,000 pounds, the elevator will be by far the heaviest duty elevator ever to be installed in a commercial ship. In addition it will have a radically new feature in a turntable that will permit the easy storing of automobiles in the hold. This turntable will be manually controlled and will operate on the elevator platform.

Soap Bubble Glass

AN aid to the doctor in treating certain ills is the ultra-violet lamp. Such lamps with quartz bulbs have been used but are necessarily expensive because of the quartz. Glass is much less expensive and also much less effective, since only a fractional part of the ultra-violet rays filter through the ordinary glass bulb. The solution lies in making the glass as thin as a soap bubble—2/10,000 of an inch. Certainly a whole bulb made of this glass would also have about the durability of a soap bubble. The secret lies in making the bulb of normal thickness and setting into it a window made of the thin glass. This passes a concentrated beam of ultra-violet with which the doctor may treat various ailments.—*A. E. B.*

THE NEW NAVAL BUILDING PROGRAM

(*Continued from page* 188)

and are a tribute to the energy, resourcefulness, and elasticity of the Navy. Their achievement is something the nation may well be proud of, and their standard must not only be maintained but advanced wherever possible.

Due to the unbalanced state of the world today no one can predict how or when the United States will urgently need a strong navy to safeguard its immense interests, which are so intimately connected with its domestic security and economic welfare. We need, therefore, a treaty navy of ships, fully manned and adequately served by bases.

The situation that we will ever have to face in an emergency is the "now situation" and the force we will have to meet it will be our "now navy," and this "now navy" is the one that we must strive to maintain at full strength and 100 percent efficient.

The sea is our outlet for surplus material, and the highway for our foreign trade and all American participation in the life of the community of nations. In proportion, as America is strong on the sea, her voice in world affairs will be strong: in proportion, as America is weak on the sea, so is she weak everywhere.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Streamlined Motor Vehicles

WE have recently had brought to our attention a patent issued by the United States to Paul Jaray of Friedrichshaffen, Germany, on the 7th day of June, 1927, No. 1,631,269, for a motor car. The application was filed on the 19th day of August, 1922. In view of the streamlined automobiles being offered this year by various manufacturers, we believe that this patent will be of wide general interest.

The accompanying illustrations show two forms of motor car described in the patent.

The patentee states:

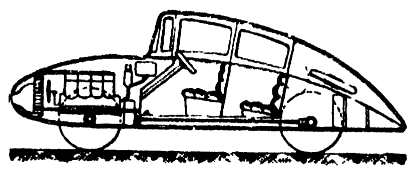
"My invention relates to motor cars and more especially to the construction and configuration of the body and the top of power vehicles, the intention being to reduce the resistance to air in the highest degree attainable, as well as to diminish as much as possible the raising of dust. I attain these objects by providing for an appropriate guidance of the currents of air. I am aware of the fact that it has already been proposed to shape, for diminishing the resistance to air of the vehicle, the various parts of this latter in such a manner that a more favourable discharge of the air could be expected.

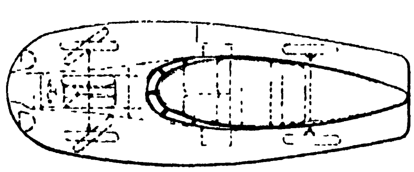
"The motor cars hitherto built deflect in most cases the air to the sides of the car transversely to the road, there being at the same time produced a correspondingly great resistance, a loss of power, strong eddies, and, at the rear of the car, an obliquely upwards directed air current, combined with a very considerable partial vacuum, whereby the dust is torn upwards into the eddies following the car. These undesirable effects are favored by the many projecting parts of the car, such, for instance, as the driving-gear boxes, the differential axles, the springs, and the like, these and other projecting parts loosening and raising the dust already whilst the car is running. Besides, the rear car surface which, with most cars, is rearwardly inclined in upward direction, acts as a guide for the whirling-up dust-laden air.

"The present invention obviates the above-mentioned drawbacks by enclosing practically all material parts of the vehicle, i.e., the entire driving plant, the useful spaces, the seats, the baggage holder, the underframe, the upper portions of the wheel, and so on, in a body-forming shell having practically the shape of one-half of a streamline body, the section plane of which extends practically parallel to the road, this shell or body deflecting the air chiefly upwards, as well as rearwards over its top and then down to the bottom with the least disturbance possible.

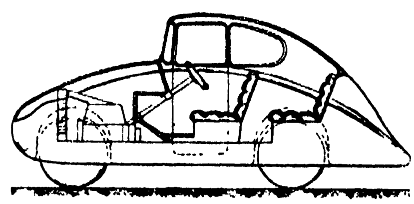
"The half streamlined shell or body may carry another body portion or top which affords the driver and the passenger a free look-out and is shaped conformably to the lower main portion, especially at its rear, and with special consideration to the guidance of the air.

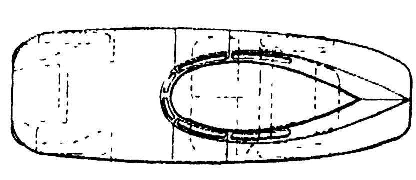
"In the constructional design the supporting structure of the upper streamline body is preferably continued to and into that of the lower streamlined body and is there supported directly by the frame girders which may extend underneath the axles of the car. This supporting structure forms the longitudinal bond or bracing proper of the vehicle, the upper girths of which, following, for instance, the course of the streamlines in the direction from bow to stern, extend to about the broadest place of the upper body, pass then upwards





Above and below: **Side and top elevations, taken from patent drawings, of the streamlined motor car bodies patented by Jaray in 1927**





to the top or the roof through the bracings of the window carriers, and finally extend downwards to the stern."

There are twelve claims in the patent, of which we reprint the most comprehensive:

3. A motor car comprising a complete hull shaped substantially like the upper half of a streamlined body.

4. A motor car comprising a hull shaped substantially like the upper half of a streamlined body, the rear end of which terminates in a transverse edge.

5. A motor car comprising a hull shaped substantially like the upper half of a streamlined body, the front and rear ends of which terminate in transverse edges.

6. A motor car comprising a hull shaped substantially like the upper half of a streamlined body, the rear end of which terminates in a transverse edge substantially at a level with the bottom of said body.

7. A motor car comprising a hull streamlined in front and on top, the bottom being substantially plane from fore to aft, and wheels having their upper halves surrounded by said hull.

8. A motor car comprising a chassis, a motor, a seat and wheels and an envelope having the form of one symmetric half of a drop and entirely surrounding said chassis, motor and seat and the upper halves of said wheels.

9. A motor car comprising a shell, the vertical longitudinal section of which substantially, resembles the vertical longitudinal section of the upper half of a stream line body, and a materially shorter hood similar in vertical longitudinal section mounted on top of and substantially on the rear half of said shell

It will be noted that many of these claims are quite broad in scope.

We understand that the owners of this patent maintain that it covers the first *completely* streamlined automobile.

The advantages of streamlining a motor driven vehicle have long been known. It is contended that when a conventionally shaped motor car is driven at high speed the air pressure on the front not only resists forward movement but the back of the car creates a partial vacuum which retards its speed. By streamlining a car it is supposed to direct the flow of the air in such a manner as to practically do away with the air pressure at the front and the formation of a vacuum at the back as the car travels through the air at high speed.

The advantages and disadvantages of streamline construction have been put forth in the last two issues of this magazine. ("Streamlining and Your Automobile," by Professor Alexander Klemin, February, and "The New Terranautics," by William B. Stout, March.) If the car of the Jaray patent will approximate the advantages of fuel economy at high speeds that are now being sought, it would seem to have anticipated a long step forward in motor-car construction.

Denmark Reciprocal Copyright Relations With U. S.

A DANISH ROYAL decree dated September 12, 1933, provides that the provisions of the law of April 26, 1933, regarding authors' and artists' rights shall be applicable to literary and artistic works produced by citizens of the United States either when the works have not been published or when they are brought out for the first time within the territory of the United States or in another country which has not approved the Berne Convention for the protection of literary and artistic works, although only in so far as the works in question fulfill the conditions requisite for protection under the laws of the United States, according to Assistant Trade Commissioner Pearson.

Books SELECTED BY THE EDITORS

SHARK! SHARK!

By Capt. William Young and H. S. Mazet, F.R.G.S.

WHAT a book! It starts off with a bang on the opening page and either you won't lay it down till the final page or you are not half human. There are lots of shark stories that are thrilling, and lots of books about sharks that are scientifically accurate though stupid, but here is one that thrills and is scientifically accurate. Captain William Young is the world's leading shark shark. Here is what Count Luckner says about him in a foreword: "He is the outstanding expert with practical knowledge about all different kinds of sharks. I feel happy to say that I had the opportunity to meet Captain Bill Young and get well acquainted with him. For many hours we have been sitting together in the cabin on board my schooner and I have been all ears listening to this congenial man telling me about his hunting and adventures with different kinds of sharks. I have finally persuaded him to put his experience and knowledge in book form, assuring him he would gain the admiration and friendship of every deep-sea fisherman and sportsman."

The best thing about this book, from the point of view of readability, is that it is scientific—leading ichthyologists were glad to lend a hand and check the author's manuscripts for accuracy. But you won't be made conscious of this fact as you read, because it is all story (except the final chapter, where some non-narrative sharkology is isolated). The details of the many stories are, however, scientifically accurate and thus you learn sharkology painlessly—unless the gruesome tales themselves should pain you. Some of these may "make your hair curl" and, if not, some of the numerous illustrations surely will. The book fully disposes of the myth that the man-eating reputation of sharks is a myth. Bound in a real sharkskin back. —$4.20 postpaid.—*A. G. I.*

NATURE, M.D.

By Richard Kovács, M.D.

A HUMANIZED explanation of the healing forces of heat, light, water, electricity, and exercise, written by a past president of the New York Physical Therapy Society, but *not* intended as a "self-treatment" manual. Rather, it is an explanation of the facts of physical therapy and just what this branch of medicine can and cannot do. Many of the claims of charlatans and faddists are here exploded and the reader is given the facts, unshrouded by extravagant claims couched in misleading terminology. You have read and heard much about the healing qualities of the agents mentioned above; here is an opportunity to get at the truth in one compact and concise volume.—$2.15 postpaid.—*A. P. P.*

BRASSEY'S NAVAL AND SHIPPING ANNUAL - 1934

THIS latest edition of a famous authority contains discussions by well-known naval men on Naval Forces of the British Empire, Foreign Navies, Comparative Naval Strength, The Disarmament Conference 1933, Physical and Recreational Training, The Building of a Cruiser, and British Warship Building Resources. In addition, there is a Marine Shipping Section which covers various phases of world shipping in eleven chapters; also numerous references, tables, and profiles and plans.

As possessors of former editions will know, it is a volume indispensable to naval and merchant marine men and all those interested in marine problems, construction, and design.—$13.50 postpaid.—*F. D. M.*

JUNGLE BEES AND WASPS OF BARRO COLORADO ISLAND

By Phil Rau

THOSE who are interested in bees and bugs and natural history will enjoy this charming account of the wild bees of Panama—stingless bees, social wasps, solitary wasps, and so on—written by a biologist and ecologist and very favorably commented on by Professor William Morton Wheeler of Harvard, the ablest scientific authority on the social insects. 317 pages, illustrated.—$2.90 postpaid.—*A. G. I.*

URBAN SOCIETY

By Noel P. Gist and L. A. Halbert

A CIVILIZATION embracing a highly developed specialization of labor is necessarily focalized in urban communities serving extensive "hinterlands" or market areas. Activities in the city itself assume characteristic patterns, depending on geographic conditions, population traits, and economic functions. The authors have adopted as their frame of reference this selective distribution of urban phenomena. They survey from that standpoint the functions and institutions of the modern city, together with its social problems and pathologies. The comprehensiveness and thoroughness of their treatment make it indispensable to college students, community organizers, and others who would gain a deeper insight into urban society and the rôle it plays in modern civilization.

This book is written in the style of a textbook and contains 699 text pages. —$3.70 postpaid.—*A. G. I.*

A LIVING FROM THE LAND

By William B. Duryee, Secretary of Agriculture, State of New Jersey

SUBSISTENCE farmers having sprung up by thousands during the recent years, this exceedingly practical little book is most timely. Addressed directly to the city man who has turned to the farm, it gives detailed instructions on all phases of farming to the man who wishes to live in the country on a completely or partially self-sustaining basis. It answers thousands of questions which the author has received in his official capacity, concerning the construction of country houses, the production of crops, garden foods, home fruits, bees, poultry, milk supply, and marketing. Its 189 pages are well illustrated and a reference list in the back pages gives the titles of numerous publications, both books and magazines, helpful to the prospective subsistence farmer.—$1.65 postpaid.—*F. D. M.*

APPLIED X RAYS

By George L. Clark, Prof. Chem., Univ. Ill.

THOSE who are interested in X rays from any point of view, whether purely scientific or industrial, will find this the recognized "standard" treatise on the subject, the first edition having appeared six years ago and won that place. The new edition is not a mere revision but is wholly rewritten, in order to bring it up with the recent great advances in X-ray knowledge. The 461 pages of text deal with two general aspects of the subject: the general physics and application of X rays (170 pages in all), and the X-ray analysis of the ultimate structures of materials

(291 pages). Of these the first covers the nature of X rays; their generation and properties; X-ray tubes; high-tension equipment; X-ray spectra; chemical analysis from X-ray spectra; absorption and scattering; radiography; and the physical, chemical, and biological effects of X rays. The second part deals with crystals and X-ray diffraction; the new crystal chemistry (a remarkable new science in itself); structure of alloys; crystal structure of carbon compounds; X rays in metallurgy; and so on. This is a *practical* book for the industrial research worker and general student. While its complete understanding presupposes a knowledge of college physics, other readers will derive relatively much from its pages. It has 239 illustrations and measures 6 by 9 inches.—$5.20 postpaid.—*A. G. I.*

NATURE CHATS

A Year Out-of-Doors

By John Harvey Furbay

EVERYONE who has the least desire to get closer to nature, to know intimately the plant and animal life of the out-of-doors, will find a wealth of material in this little book. Prepared in sections according to seasons, and the sections subdivided into a total of 52 chapters, the sequence of material carries the reader around the calendar in an easy and entirely readable manner. The author has eliminated "scientific" terms and other matter which would interest only the professional naturalist and has produced a book that has wide general appeal. The text is nicely illustrated with many drawings. Ten chapters in the appendix give explicit instructions on practical nature study: How to preserve plant and animal specimens, how to make an insect collection, nature projects for all year 'round, bibliography, and a short list of supply houses where materials may be purchased. Altogether an excellent guide for all nature students. 5½ by 8½ inches, 255 pages, stiff covers.—$1.90 postpaid.—*A. P. P.*

AMERICA SELF-CONTAINED

By Samuel Crowther

THAT America is virtually self-contained and therefore can and should stand alone, thereby remaining entirely free to control her own destinies, is the theme of this latest book by the widely known biographer of Henry Ford. The recent turning in our political destinies provides a ready means of making this change, all but existent anyway, in our economic destinies. The notion that foreign trade contains some magic to make us whole is fallacious. Our market is at home—we should ourselves make whatever we need and use it. Let us avoid entangling ourselves with other nations; we need no friends (and have none), and we fear no enemies. The plea all through this work, which is stuffed with economic fact and argument, therefore harks back to George Washington's well-known farewell advice to the nation.—$2.15 postpaid.—*A. G. I.*

SAILING CRAFT

Edited by Edwin J. Schoettle, with an introduction by A. Edward Newton

THIS handsome 7½-inch by 11¼-inch volume, of 786 pages, formerly sold for twelve dollars. This new edition, at reduced price, is identical with the original volume, is printed on heavy

coated paper and contains several hundred illustrations.

Mr. Schoettle is one of the best informed men in the country on small boat sailing and racing; and his Sailing Craft is a compilation of articles by him and his friends, among whom are to be found most of the expert boat designers and manipulators. There is a chapter on sailing canoes and a fine discussion of the many classes smaller than the *Shamrock* yet larger than a canoe. General chapters cover classification, ocean racing, aerodynamics of yacht sails, cruising, regatta committee work, and so on. In each are discussed all sorts of craft from a bilge-board scow, a Biloxi schooner, a Chesapeake bugeye, to a New York 30. This most complete volume may now be had at $4.50 postpaid. —*F. D. M.*

PHYSICAL OPTICS

By Prof. R. W. Wood

WOOD'S "Physical Optics" has been a standby for many years but it gradually became out of date, the previous edition having been published in 1911. Its author, who is Professor of Experimental Physics at Johns Hopkins University, has now very largely rewritten it, bringing it up to date—a monumental task, its length being 831 pages. Workers in optics will rejoice to know that this famous book is once more available. Amateur telescope makers who have been making a general study of optics should own it, either as a study or reference work. The scope is best indicated by the chapter heads: Nature and Rectilinear Propagation of Light; Reflection of Light from Surfaces; Refraction; Absorption and Dispersion; Origin of Spectra; Interference; Diffraction; Interference Spectroscopes; Polarization; Double Refraction; Meteorological Optics; Theory of Reflection and Refraction; Scattering; Raman Effect; Theory of Dispersion and Selective Reflection; Optical Properties of Metals; Rotary Polarization; Resonance Radiation and Fluorescence of Atoms; Resonance and Fluorescence Spectra of Molecules; Fluorescence and Phosphorescence of Solids and Liquids; Magneto-Optics; Electro-Optics; Thermal Radiation; Relative Motion of Ether and Matter. The language is clear and lucid. The text is partly mathematical (calculus). This book is not recommended for beginners. It is the "last word," however, when looking up obscure corners of optics, also for gaining a better than superficial background. 6 by 9 by 1½ inches. 462 illustrations.—$7.75 postpaid.—*A. G. I.*

MYSTERY, MAGIC, AND MEDICINE

By Howard W. Haggard, M.D.

THIS pocket-sized book, written by the author of "Devils, Drugs and Doctors" (a best seller), who is Associate Professor of Applied Physiology at Yale University, contains in 191 pages a survey of the rise of medicine from superstition to science—from ancient times to our own age—and is a compact, informative, authoritative history of medicine which has the especial merit of being really readable. A true romance is what the history of the rise of medicine has been, and the reader of this book will live it through vividly with the author. The volume is nicely produced- nice type, paper, covers, and illustrations.—$1.10 postpaid. —*A. G. I.*

FORD MODELS V-8, B, AND A CARS

By Victor W. Page

THIS practical treatise describes the principles of operation of all the parts of the latest model Ford cars, and gives complete instructions for driving, repairing, and servicing them. This book is heartily recommended to all owners and drivers of Fords, as well as those who have occasion to work on them in any capacity. The treatment of the V-8 and the A models is remarkably complete, but the model B is given scant attention. Numerous drawings and photographs illustrate the text and aid in elucidating obscure points.—$2.65 postpaid.—*A. P. P.*

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NINETIETH YEAR • ORSON D. MUNN, Editor

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Cover

THE striking aerial view of a large lumber mill is used through the courtesy of The Shevlin-Hixon Company of Bend, Oregon. This organization, with commendable foresight, has long realized that lumbering cannot go on indefinitely without replacement. Acting on this thought, they have conducted extensive field experiments in selective cutting and reforestation, to the end that they may have a constantly replaced source of supply.

SCIENTIFIC AMERICAN, May, 1934 Vol No 150, No 5, entered at the New York, N Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879, additional entry at Greenwich, Conn Published monthly by Munn & Company, Inc, 24 West 40th Street, New York City. Copyrighted 1934 by Munn & Company, Inc. Great Britain rights reserved Subscription price $4 00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

FROM the earliest days of naval activities, modernization of battleships has been a familiar process in the progress of nations. Today, modernization has assumed aspects not dictated solely by considerations of cost, as in the past, but primarily by the prohibition against new construction contained in the provisions of the Washington Conference of 1921-1922. That this provision has been particularly hard on the United States, because of the almost obsolete ships with which it left us, can not be denied. The situation has been met, at least in part, however, by modernization of old ships. Capt W. D. Puleston, U.S.N., a writer whose work is familiar to our readers, has prepared an article, scheduled for next month, on the procedure followed in bringing up-to-date the U.S.S. *Mississippi.* The modernization of a battleship involves so many considerations, and calls into play so many of the sciences that the article mentioned will interest every reader.

●

"THE world at your fingertips" is no figment of the imagination when the phrase is applied to modern short-wave radio. The antipodes is at the greatest distance from which radio messages can be received, and thus is placed the only practical limit on the range of a well designed short-wave receiver. Here is a new field for entertainment; an opportunity to recapture those old thrills of DX of the early days of broadcasting. An article in an early issue will tell of the results to be expected with short-wave receivers, and something about the sets themselves

●

THE average angler thinks that he is applying scientific methods to his sport when he tries to put himself in the place of his quarry and assumes that fish see, hear, and smell as does a human being. As a matter of fact, this assumption, and the consequent course followed, may be the very reason why the angler has to rely on "fish stories" when telling of his success. We quote the following from an article, to be published very soon, by J. E. Nielsen, B.Sc.: "Due to a difference between air and water the sensory organs of fishermen and fish have developed along different lines. Fish do not see nor hear nor smell . . . as we do." Mr. Nielsen goes on to make an excellent case for putting scientific angles in angling.

●

NITROGEN, the inert gas that constitutes about three quarters of our atmosphere, is an absolute necessity to civilization in both peace and war. In usable form it becomes the basis of fertilizers that make possible yearly crops from land that otherwise would be completely exhausted in a few years; it also is indispensable in the manufacture of war munitions. Thirty years ago 63 percent of the world's nitrogen supply came from Chile. In 1933, less than 10 percent came from that source. Just what has been the process by which Chile lost her hold on this world market? The story of the determining factors in the case is told in an article to be published soon, in which the author takes up the economics of the situation, and points out certain facts that must be taken into consideration when looking to the future of nitrogen in world affairs.

NEXT MONTH

¶J. H. Landman, Ph.D., J.D., J.S.D., will write on the aspects of racial betterment by human sterilization.

¶Capt. W. D. Puleston, U.S.N., contributes an important article on the modernization of the battleship *Mississippi.*

COMING

¶Hon. Henry A. Wallace, Secretary of Agriculture, on the social implications of scientific research.

¶Scientific angles of angling, by J. E. Nielsen, B.Sc.

¶Logan Clendening, M.D., noted author of accurate and interesting medical articles for the layman.

¶Victor W. Eisenstein, with a provocative article entitled "The Oddest Thing About Jews."

●

"WHAT is human sterilization? Are castration and human sterilization alike? What effects has sterilization upon the individual, particularly on the sexual life? What people should be sterilized? What countries now practice compulsory sterilization? What are their experiences with this type of legislation? These and many other questions come to mind as one cogitates about eugenic sterilization as a social therapeutic agency." Thus writes J. H. Landman, Ph.D., in an article on sterilization to be published next month. A survey of sterilization and its possibilities is highly desirable at this time, due to widespread agitation for its use in many quarters, and Dr. Landman has attacked the subject in a calm and unprejudiced manner.

●

NOW that much of the furor of the Army-airmail fiasco has calmed down, it is possible to view the entire subject from a sane perspective. To get just this angle, Reginald M. Cleveland, whose aviation articles are familiar to SCIENTIFIC AMERICAN readers, has been asked to gather data and render as complete a report as possible in time for our June issue. Watch for this article; we guarantee that it will be worth reading.

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AND next month, as always, the Scientific American Digest. Ten pages or more of short, accurate, articles on all branches of applied science, profusely illustrated.

Orson D. Munn

Editor and Publisher

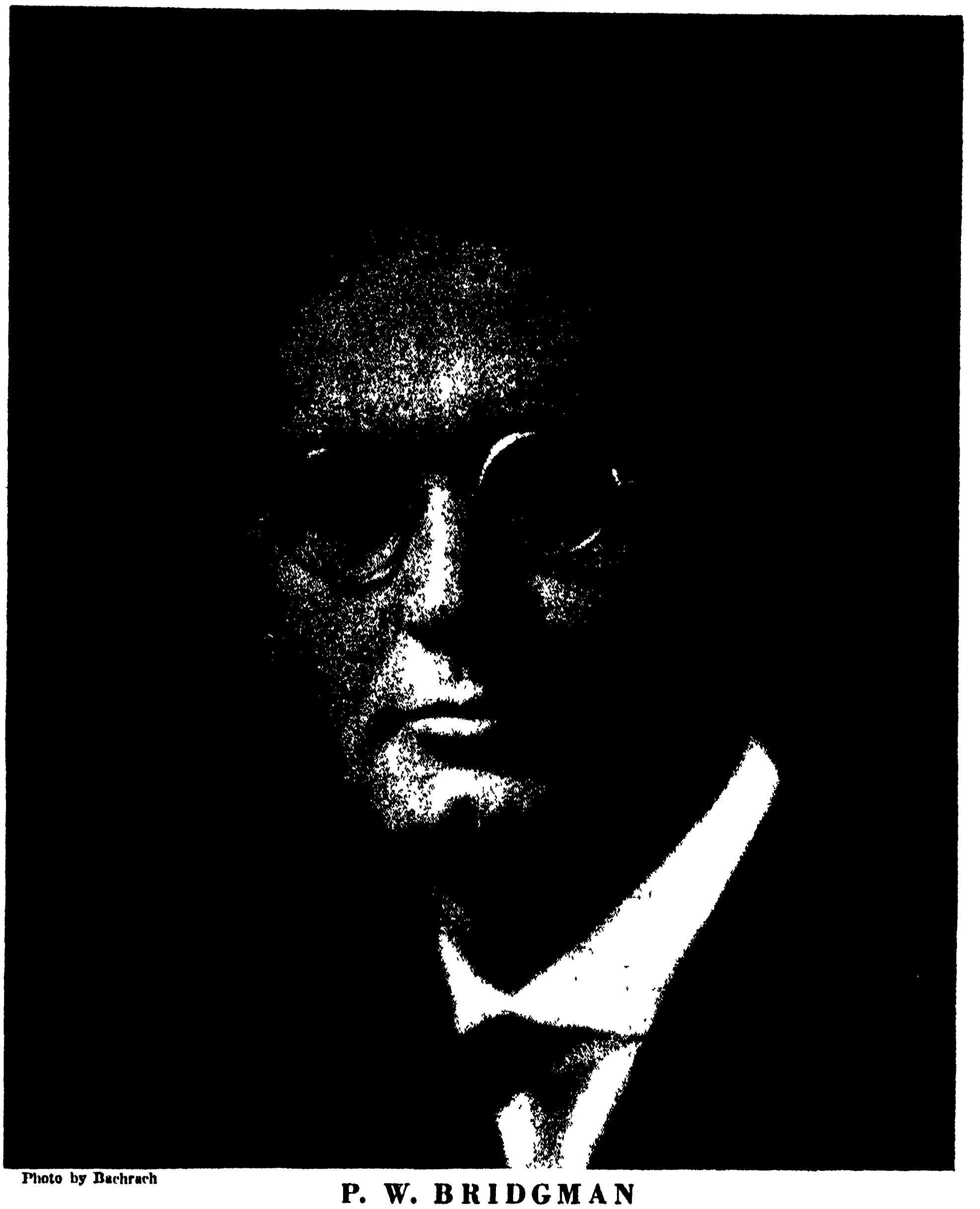


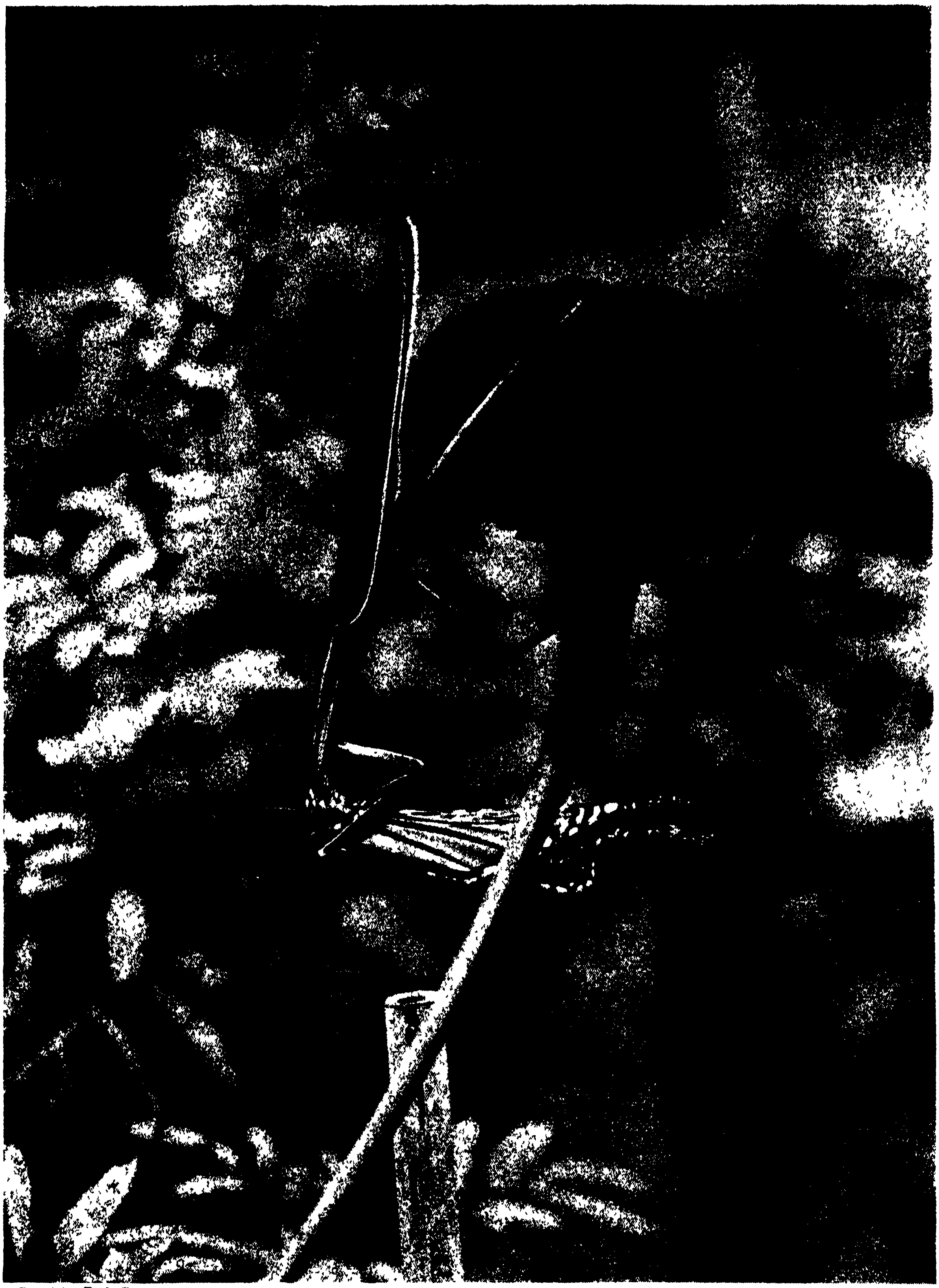
Photo by Bachrach

P. W. BRIDGMAN

RECENTLY the Comstock Prize of 2500 dollars was presented by the National Academy of Sciences to Dr. P. W. Bridgman, Professor of Mathematics and Philosophy at Harvard University, because of his brilliant achievements in advancing our knowledge of the behavior of matter. The National Academy says of his work:

"Bridgman is both an experimenter and a theorist. Working indefatigably in a field of great experimental difficulty, he has derived an enormous array of fundamental facts, while new insights and physical concepts have come from the keen analysis of his theoretical studies. Most of Bridgman's work falls into three categories: the first, so peculiarly his own, the behavior of materials under high pressure; second, the properties of single crystals at normal pressures; and, third, the application of thermodynamics to electrical phenomena."

It was Professor Bridgman who devised and used apparatus for applying pressures up to 600,000 pounds per square inch, the highest pressures ever attained artificially. This research was described in his book "The Physics of High Pressure." Regarding his philosophical work the National Academy of Sciences continues: "In addition to his many contributions to the form and substance of his own special branch, Bridgman has served the broad field of science in a most significant way. It has been an unusual and gratifying experience to read, from his pen, scientific philosophy that is both philosophical and scientific. Such contributions could perhaps be made only by that rare person who is at the same time a gifted experimenter, an able theorist, and a sensible man."



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THE AGE-OLD SURVIVAL OF THE FITTEST

A PRAYING mantis (*Paratenodera sinensis*) hangs from an African marigold, calmly lunching on a butterfly, while the photographer, with an ordinary view camera, takes its picture. The forelegs of the mantis, with which it is holding its meal, might more properly be called arms, since they are usually used for holding, rather than for locomotion. This particular mantis, introduced into this country from China some 30 years ago, is now becoming quite plentiful in the Middle Atlantic and southern New England states. They are valuable for controlling insect pests.

Taking blood from the finger for the blood tests for paternity—two drops are enough

WHOSE BABY?

Determining Parentage by Blood Groups

By LAURENCE H. SNYDER
Professor of Zoology, Ohio State University, Columbus, Ohio
Author of "Blood Grouping in Relation to Clinical and Legal Medicine"

IN South Dakota, a man claims that he is the father of one of a pair of twins, but not of the other. In Illinois, a mother contends that she has been given the wrong baby to bring home from the hospital. In Connecticut, a man denies being the father of an illegitimate child when accused by the mother. These and similar cases offer opportunities for using the blood group tests.

The past few years have seen the discovery of many new and interesting facts about human inheritance. Among the many characters which are transmitted from parents to children by heredity, none is more fascinating than the blood groups, represented by those curious substances called agglutinogens found in the red blood cells. With the microscope and the proper test serums, the scientist can now determine to what blood group any person belongs. From a knowledge of the blood groups many questions concerning individuality and paternity can be answered. To understand the nature of these tests it is necessary to go back to the beginning of the present century.

In 1900 Dr. Karl Landsteiner, working in a medical laboratory in Vienna, discovered that when he mixed the red blood cells of one person with the serum, or clear part of the blood, of another person, a surprising reaction sometimes occurred. This reaction was the clumping, or gathering, of the red blood cells into little bunches. The clumping reaction is technically known as agglutination. This reaction did not happen in every combination of serum and cells, but only when the cells of certain people were mixed with the serum of certain other people.

THE agglutination, or clumping, is due to a substance in the red cells being acted upon by an antibody in the serum. The substance in the cells is called an agglutinogen. It soon became apparent that there were two such substances in human red cells, acting very much alike. For convenience, the two substances were named A and B.

It was found by Landsteiner and others who took up the investigations that a person whose blood was examined might have one of these substances in his blood, or he might have the other, or he might have neither of them, or he might have both. There were thus four kinds of people in respect to these substances. A person having substance A in his red blood cells is said to belong to group A; a person having substance B belongs to group B; a person having both substances belongs to group AB, and a person having neither of them belongs to group O.

Originally the four groups were designated by numbers, I, II, III, and IV, but it so happened that two different scientists, one in America and one in Europe, each proposed a numbering system, and groups I and IV were just opposite in the two systems. To do away with the resulting confusion, the letter system was adopted, and the groups are now called O, A, B, and AB.

The first practical application of the knowledge of blood groups was in blood transfusions. It can be seen at once that if a man loses blood in an accident, and needs to have blood given him, that it would not do to have the blood cells clump up into bunches as fast as they were given. For one thing, they could not go through the fine capillaries which connect the veins and arteries. Therefore, before every transfusion a test is made to make sure that the blood given will not have its cells agglutinated by the serum of the patient.

Shortly after the importance of blood

groups in transfusion was recognized, students of human inheritance began to pay serious attention to the possibility that the groups might be inherited. The blood groups of families were studied in laboratories all over the world, with the result that a large body of knowledge was accumulated on the behavior of these blood substances in parents and children. This behavior was found to be very definite, and to obey fixed hereditary laws. It was found, for example, that substance A never appeared in the blood of a child unless it was also present in the blood of at least one of the parents. Likewise substance B never appeared in a child's blood unless it was present in the blood of the father or mother, or both. These two laws form the basis for the use of the blood groups in legal cases.

Table I
Blood Groups of Parents and Children

Blood Groups of Parents	Blood Groups which may occur in Children	Blood Groups which can not occur in Children
O x O	O	A, B, AB
O x A	O, A	B, AB
A x A	O, A	B, AB
O x B	O, B	A, AB
B x B	O, B	A, AB
A x B	O, A, B, AB	
O x AB	A, B	O, AB
A x AB	A, B, AB	O
B x AB	A, B, AB	O
AB x AB	A, B, AB	O

Other laws are also known in the inheritance of the blood groups. For example, if one parent is group AB, that parent must give either A or B to each child. Therefore a parent of group AB could not have a child of group O. Likewise if a child is of group AB, he always receives the substance A from one parent and B from the other, so that a child of group AB could not have a parent of group O. These laws are known as a result of the study of many thousands of families, and they carry added weight because they represent a type of heredity well known to students of inheritance.

THE various combinations of blood groups which can occur in parents, and the kinds of children they produce, are shown in Table I. It may be seen from the table that the blood groups of the children are not always like those of the parents, nor are brothers and sisters always of the same group.

From Table I it may easily be seen that babies who were mixed in a hospital might in many instances be untangled by means of the blood groups. For example, in a recent case two mothers went home from the hospital at the same time, each with a new baby. Upon bathing her baby, mother number 1 found the name of mother number 2 on a tag on the baby's body. A court case resulted, and after various attempts to settle the question had failed, the blood tests were made. The parents of family number 1 were both of group O, and the baby they took home with them was group A. In family number 2, the father was group O and the mother was group AB, and the baby they took home with them was group O. A glance at Table I will show that neither family could have produced the child they took home, while each could have produced the other. Clearly, then, the babies had been given to the wrong mothers, and the court ordered the babies exchanged.

Table II
Medico-legal Applications of Blood Groups

Blood Group of Child	Blood Group of Mother	Blood Group to which Father must belong
O	O	O, A, or B
O	A	O, A, or B
O	B	O, A, or B
A	O	A or AB
A	B	A or AB
B	O	B or AB
B	A	B or AB
AB	A	B or AB
AB	B	A or AB
AB	AB	A, B, or AB

IT may easily be seen that in some instances both babies might be of the same group, or both families might be of the correct combination to produce either child. In such cases, the blood tests would not prove anything. It has been computed, however, that these blood tests can solve about one third of the cases of mixed babies.

Another legal use to which the blood groups may be put is the question of disputed paternity. The laws of inheritance stated above may be placed in the form of another table, as shown in Table II. The fact that an agglutinogen never appears in the blood of a child unless it was present in the blood of at least one of the parents may be used as follows. Suppose a child has substance A in his blood, and the mother does not have this substance. Then we know that the child's father must have substance A in his blood. Therefore a man who does not have substance A in his blood could not be the father of the child. In this way a man of group O or group B would be cleared in the charge of the paternity of this child. A man of group A, or of group AB, having substance A in his blood, *might* be the father of the child, but could never be proved to be the father, as there are many men in the world of group A or group AB. Thus a man may be exonerated by the blood tests, but he could never be incriminated.

Table III
M-N Reactions in Parents and Children

Parents	Groups to which Children may belong	Groups which can not occur in Children
M x M	M	N, MN
N x N	N	M, MN
M x N	MN	M, N
M x MN	M, MN	N
N x MN	N, MN	M
MN x MN	M, N, MN	

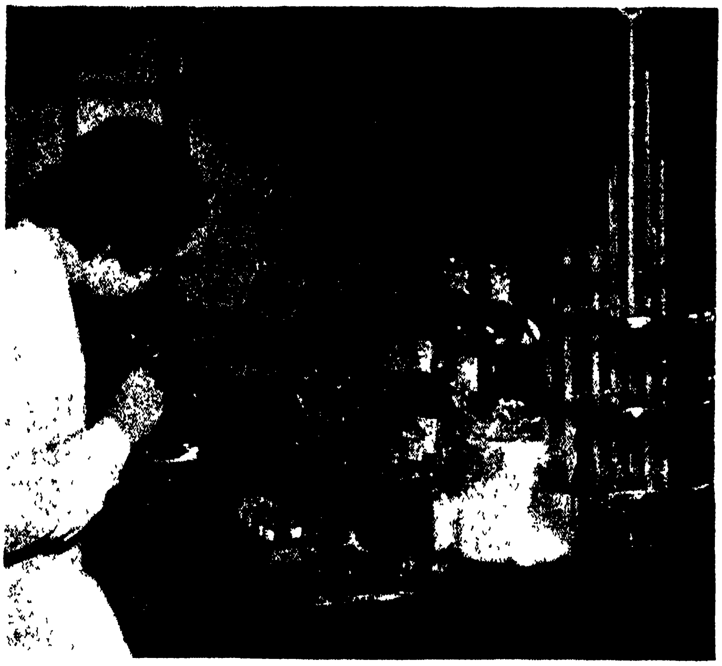
In a recent case under my observation, a man was accused of being the father of an illegitimate child. He denied this, and had a blood test made. The mother was group A and the child was group B. The child thus had substance B in the blood cells, and the mother did not. The substance B must therefore have been inherited from the child's father. The man in question was of group A, like the mother, and therefore could not have been the father of the child.

IN another instance which I recall, the mother and child were both group O, and the accused man was group A. Thus he could have been the father of the child, but so could any other man of group A, or any man of group B, or any man of group O. In this case the accused man could not be proved innocent, but neither could he be held guilty by these tests. To repeat, a man may in certain instances be proved *not* to be the father of a given child, in certain instances it may be said that he *could* be the father, but it can never be proved by the blood tests that any man *is* the father of a certain child.

Recently two new substances, similar in many ways to substances A and B, have been discovered in human blood. These new substances have been named M and N. They, too, have been studied in families, and laws have been found for their inheritance. It is found that some persons have substance M in their blood, others have substance N, and still others have both substances. No one ever lacks both substances. These

Table IV
Medico-legal Applications of the M-N Reactions

Child	Mother	Group to which Father must belong
M	M	M or MN
M	MN	M or MN
N	N	N or MN
N	MN	N or MN
MN	M	N or MN
MN	N	M or MN



Examining the blood through the microscope after the test serums have been added. The four typical appearances are shown below

substances occur quite independently of the longer-known agglutinogens A and B, so that 12 combinations are possible. Thus every person belongs to one of the following groups:

O, M	B, M
O, MN	B, MN
O, N	B, N
A, M	AB, M
A, MN	AB, MN
A, N	AB, N

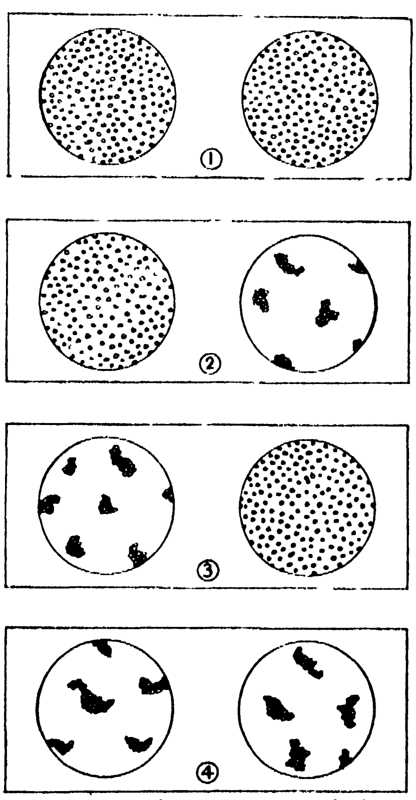
As in the case of the substances A and B, we find that substance M never occurs in a child's blood unless it is present in the blood of at least one of the parents. The same is true of substance N. Tables III and IV show the possibilities of legal applications in the case of these agglutinogens.

By using the new tests for M and N, as well as the tests for A and B, an even larger number of disputed paternity cases or mixed baby cases may be settled. The use of all the tests will exonerate a man who is falsely accused of paternity in about a third of the cases, and will untangle mixed babies in about two thirds of all cases.

The substances M and N do not have to be taken into consideration in transfusions, since no one has any natural antibodies against them in his serum Therefore the diagnostic serums for these substances are prepared by injecting M blood or N blood into rabbits. In the case of the substances A and B, some people have the antibodies against them occurring naturally in their serum. A person always has the antibody against the substance which is lacking in his blood. Thus a person who has B in the cells has no antibodies against B, but does have the antibodies against A.

THE test to determine which of the substances A, B, M, or N a person has in his blood is made by mixing some of the person's cells under the microscope with various serums each of which is known to have a particular antibody. If any serum produces agglutination (clumping), the cells must contain the substance which the particular antibody agglutinates.

Thus, if we were to examine a person for his blood group, we would first take a few drops of his blood from the finger or the lobe of the ear. In the case of a very small child the blood is usually taken from the heel. The drops of blood are collected in a tube containing isotonic saline solution. This makes a pinkish suspension of the red blood cells. Then, to make the test for the presence of substance A or B, a drop of the cell-suspension is placed on each end of a small glass slide. To the left-hand drop is added a drop of serum containing the antibody against substance B. This serum would be previously prepared from persons of group A, who have the antibody against B naturally in their serum. To the right-hand drop of cell-suspension is added a drop of serum containing the antibody against substance A. This serum would be previously prepared from persons of group B.



Diagrammatic appearance of the A-B blood groups under the microscope. On each slide the unknown cells are mixed with group A serum on the left, and group B serum on the right. Slide 1, group O; slide 2, group A; slide 3, group B; 4, AB

The drop of cell-suspension and the drop of serum are thoroughly mixed at each end of the slide, and then the mixture is examined through the microscope. The results are shown in the drawing. If, for example, the cells are agglutinated by the antibody against A, they must, of course, contain substance A.

The test for the presence of M or N is similar, but somewhat more involved, as the reaction is slower and must be speeded up to be of any value. The mixture of cells and serums in this case, therefore, is whirled for five minutes in a centrifuge at 1800 revolutions per minute and then shaken thoroughly in a shaking machine. The mixture is then examined under the microscope, and again it can be determined which substance is present in the blood cells. If the cells are agglutinated by the serum containing the antibody against M, for instance, the cells must contain substance M.

The serums containing antibodies against M and N are not taken directly from human blood as are the A and B serums. Instead, they must be made by means of a long series of injections of human blood containing M or N into rabbits. In this way the blood of the rabbits produces antibodies against M and N, and from this immunized rabbit blood the serums are prepared.

TURNING now to the possibility of twins having two fathers, we are again involved in a problem of biological inheritance. First of all we may say that the occurrence of such an event is perfectly possible, but would be almost impossible to prove in human beings. In animals, many such cases are known.

It occasionally happens that after a female animal is mated and conceives, she may mate a second time, perhaps with a different male, at which time another conception takes place. The two embryos develop together and are usually born together, although one of them may not be at full term. Thus mares which were bred first to a stallion and then to a jack, or vice versa, have been known to produce twins, one a horse colt and the other a mule colt. Similar instances are recorded in sheep, where a ewe, having been bred to two

Left: **Placing the tubes of blood in the centrifuge where they are rapidly whirled in order to accelerate the reaction for the M-N tests**

Below: **The apparatus, a simple shaking table actuated by a crank and electric motor, for thoroughly shaking the blood for the paternity tests. The portion of the apparatus on top is a reciprocating rack containing the test tubes**

Injecting blood into a rabbit, to produce the test serum for the M-N tests. The blood of the rabbit produces antibodies against M and N, and from this immunized rabbit the serums are prepared. The test first described does not require any animals. The M-N test always does

rams of different breeds, produced twin lambs, one of which clearly was of one breed, the other having every evidence of blood of the other breed. Female rabbits have been bred to two males in rapid succession, the two males being so chosen as to transmit different color qualities to the offspring. When the baby rabbits were born, young from both males were found in the litters.

Thus it would appear to be biologically possible for human twins to have different fathers. The proof of such an occurrence, however, would involve long and careful genetic tests, and it probably could never be conclusively proved in the last analysis. Such evidence as we might obtain would be collected in the following manner: First of all it would have to be proved that the twins were fraternal and not identical, since identical twins could not possibly have different fathers.

THERE are two kinds of twins among human beings: fraternal twins, which may consist of two boys, or two girls, or a boy and a girl, and identical twins, in which the two members of the pair are always of the same sex. Fraternal twins result from the separate fertilizations of two eggs by two sperms, and so the twins are just ordinary brothers or sisters who happened to be developed and born at the same time. They are no more alike than brothers and sisters born at different times. It is such twins, of course, who might conceivably have different fathers. Since a different sperm fertilizes each egg in these cases, the sperms might be from different men. Fraternal twins occur once in every 75 or 80 births.

Identical twins, on the other hand, are those who developed from a single egg fertilized by a single sperm. Usually, of course, a fertilized egg develops into a single individual. In about one case out of 300, however, the single fertilized egg starts to develop, then for some reason not thoroughly understood, divides, and continues its development as two individuals, who are identical not only as to sex, but in all their hereditary characters. Since only one sperm is responsible for both twins in these cases, it is obvious that they could not have two fathers.

In the case of twins said to have two fathers, then, we must first prove that the twins are fraternal. To do this is not so simple as it sounds. It requires a series of genetic tests, including not only the blood groups, but the study of the finger prints, taste deficiencies, *I.Q.*, anthropomorphic measurements, iris color, and so on. These tests might prove that the twins were different in some of their hereditary factors, and therefore fraternal and not identical.

When and if the twins should be proved to be fraternal, the next step in the investigation would be to make blood tests of the whole family, including the twins, the mother, and the husband. Of course both the A-B tests and the M-N tests would be made. If the blood groups showed that one twin could be the child of the husband, while the other could not, the evidence would suggest the possibility of two fathers.

However, neither twin might be the child of the father; that is, they might both be the children of the other man. To test this, a blood analysis should be made of the supposed father of the other twin. If the blood tests showed that one twin could belong to the husband but not to the second man, while the other twin could belong to the second man but not to the husband, then the evidence would favor the theory of two fathers for the twins.

However, even this would not prove the case, as it would be perfectly possible for both twins to belong to still a third man who may not even have been mentioned in the case.

RESEARCH work on blood tests such as these is going on in many laboratories in all parts of the world. More and more laws of inheritance are being discovered, and the number of cases which can be settled by such laws is increasing. Recent work makes it probable that a sub-group of group A may shortly become added to the medico-legal tests.

When the blood groups are examined in various races of mankind, it is found that while the inheritance is the same in all cases, different races have differing proportions of the A-B groups. The M-N groups have not as yet been studied in many races. The variation in proportions is quite striking, and a classification of races on this basis not only conforms very well to the standard racial divisions, but even allows the analysis of the relationships of certain otherwise obscure peoples.

American Indians appear to be entirely of group O, except where the other groups have been introduced by white admixture. Europeans and Americans are largely of groups O and A, with small proportions of groups B and AB. Asiatics, on the other hand, have more of group B than of A. The negro races have approximately equal proportions of groups A and B, with a large proportion (about half) of group O, and very little AB. From these facts certain laws of serologic race classification have been derived, which are of use to the anthropologist.

Work on the taste-producing qualities of certain synthetic chemicals is uncovering a set of hereditary taste deficiencies in people, so that the ability to taste or not to taste certain compounds may soon be added to the paternity tests. No more fascinating field for research exists than that of the inheritance of human characteristics.

OUR POINT OF VIEW

R. A. F.

WITH threatening war clouds gathering over Europe and ugly rumors appearing in the press of the world, it came as no surprise when England recently announced that in 1934 she would spend 89,000,000 dollars in building up her air force. British statesmen hastened to explain that this air construction—a part of a general building program for army and navy parity—would not, they hoped, "prove to be a starting gun in a race for air armaments." England apparently is looking solely to national security in the only way that she knows how—by securing and maintaining defensive forces capable of coping with any emergency.

We sympathize with Great Britain in her desires; we, too, hold the belief that parity of armament is the safest insurance against war. But we must disagree when her government officials hold up the United States military air forces as an object lesson in development. The recent Army airmail fiasco has shown a deplorable lack of efficient equipment in the Army Air Service. True, our commercial lines have been developed to a commendable degree, but these are not military forces any more than Army planes and pilots constitute a mail-carrying system.

If any country needs adequate aerial armament on parity with other nations, it is the United States; a start has been made and it is to be hoped that satisfactory arrangements can be made in the near future to assure such equality. If complete co-operation can be obtained between government officials, commercial airlines, plane and engine manufacturers, and our military departments, without the intervention of petty politics and unscrupulous business tactics, the United States need never worry about adequate aerial defence forces.

Sex and Sanity

SEX in the human species is the only subject in the whole realm of science concerning which science has shown the least timidity, and the only corner of human knowledge in which the human race has hesitated to pool its individual knowledge. In a sense and in large measure each of us has gone about all his life as a sort of separate "compartment," withholding or largely withholding from his fellow "compartments" most of his own immediate experience. It is true, some of us do now and then let slip a few of our sex thoughts—more or less judiciously dressed up for the occasion by our censor (more so than less) but the picture or pattern of human thought and conduct thus gained must be quite different from the true fact—inadequate and in places blank. As a result of this poor liaison between minds many persons naively assume that others are like themselves, while others—very many of these, it would appear - have gone about imagining that certain kinks in their own makeup were peculiar to themselves, and have always maintained a discreet but worried silence concerning them.

It has been the aim of psychologists, particularly within recent years, to open up and explore all of these hidden recesses—to pool the contents of the sealed compartments, as it were, so that each could at least partake of knowledge of the rest. In this way humanity would gain a better idea of what average human sex thought and conduct is. One by-product, no doubt, would be a much more charitable attitude toward others, for if we are all more or less peculiar does not the peculiar become the norm again? A second by-product would be less of the kind of worrying which, rather than the actual thing worried about, has put so many into insane asylums.

Even at best, however, such an opening up is difficult business, and in fact it doubtless never will occur directly between persons. A simpler way is through the medium of the written word—scientific books on the sex life of the human being, books which record the actual life experience of enough persons to provide a norm. Such a series of books is being made available one by one at intervals of a year or two by the National Committee on Maternal Health, a committee composed of noted physicians and psychiatrists. Conceived on a high scientific plane, the advanced research of this committee has raised the whole subject of sex out of the realm of the sensational or emotional, with which it has so often been associated, and placed it on the plane of rational, scientific undertaking.

As H. G. Wells points out, when light and air have been let in on the various aspects of sex, the present human preoccupation with that corner of our being doubtless will be relegated to a position of much more secondary importance than at present. Its mystery will have departed. Perhaps unsatisfied curiosity has been the mainstay of prurience.

Free Ports

FOR some years there has been considerable agitation for the establishment in this country of "free port" zones for foreign trade. The Port of New York Authority, in recently affirming its support for legislation establishing such zones says that it sees no panacea for foreign trade or shipping in such zones but believes Congress should permit experimentation "with this type of trade stimulator."

The free port, one of which has been urged for Staten Island, down the bay from Manhattan, is a sort of vestibule to a port of entry, a section surrounded by a customs barrier but not subject to customs. In-transit or trans-shipment trade may land in these sections, be unladen, repacked, stored, manipulated, processed, and reshipped to foreign countries with no red tape and a minimum of expense. Such zones would stimulate the use of American ports by trade moving between two foreign countries, and would, therefore, furnish employment to additional thousands of port workers. To show why this is so, the Authority says that "in Great Britain the so-called trans-shipment trade makes up from 15 to 20 percent of the total foreign trade of the country. The free port of Hamburg, Germany, is reported to have handled in one year 22,000,000 tons of freight, utilizing 11 miles of piers, 2000 cranes, and 6000 workmen"

There are many ports in the western hemisphere that have better steamship service via the United States than they have directly. This is because we are strategically located to handle products between Europe and the Orient, and between Canada and the countries south of us. Even under the difficult and expensive "in bond" trans-shipment plan, the Department of Commerce reported for 1930 approximately half a billion dollars worth of goods imported into the United States and trans-shipped, or stored, smelted, or combined with domestic products for foreign consumption.

It seems to us, therefore, that the plan of establishing a number of free ports in this country would be good business; it would attract trade.

SOUTHERN PINE FOR

By CHARLES H. HERTY

OF all our natural resources—and they represent fabulous wealth!—our forests are one of the greatest. The tremendous demands for newsprint — among other things — has, however, pushed the newsprint pulpwood "front" almost entirely across our northern border. Thus Dr. Herty's successful researches, culminating as they have in the discovery of a process to utilize a hitherto overlooked resource in young southern pines, have enormous economic value.

It is logical to envision, upon reading Dr. Herty's excellent interpretation of this important work, the gradual development of a great southern industry combining reforestation, "cropping" of young pines, and the manufacture of huge tonnages of newsprint paper.—*The Editor.*

ECONOMICS sometimes goes awry for example, in the newsprint industry.

A few years ago hundreds of millions of dollars of American capital emigrated from the United States to Canada where it was used for building great newsprint mills. From one point of view that was natural, and, of course, artificial stimulation of one sort or another accelerated the rate of this emigration

It was natural because the industry was following that type of wood (spruce) which was admirably adapted to the purpose and which was given preference over all others in newsprint manufacture. Therefore the tide changed, and, whereas the United States mills had formerly manufactured two-thirds of our newsprint consumption and imports were limited to one-third, these figures are now reversed.

In pursuing such a policy, financial interests followed the beaten path, oblivious to the fact that where logs are cut and conditions for reproduction are unfavorable costs must increase, and, eventually, the industry become extinct. On the other hand, a permanent industry under continued low costs must be sought in a region where reproduction of logs keeps pace with consumption, and where raw material can be worked up into a finished product under favorable conditions and with accessibility to consuming centers.

The conditions of such an ideal location point clearly to the South Atlantic and Gulf states, which have within their borders more than a hundred million acres of cut-over lands, and more than twenty-five million acres of abandoned farm lands.

On much of this cut-over land, left from the lumbering of the former magnificent forests of yellow heart pine, there has sprung up, despite the carelessness of the owners in protecting against ground fires, a forest of young pines (longleaf, slash, loblolly, old field and Virginia pines). Latterly, intensive fire control in several southern states has added enormously by natural reforestation to the potential pulpwood supply of this southern region.

All the real economics of the situation, free from any political or financial bias, point to the southern states as the section for a permanent newsprint industry to supply adequately the entire needs of the United States and provide for a large export business. Cheap wood, lower-priced labor under the NRA and nearness to sulfur, salt, limestone, alumina and clay make the purchase of necessary supplies less expensive; and hydro-electric power, cheap coal and cargoes of fuel oil along the coast assure reasonable expense for power and steam.

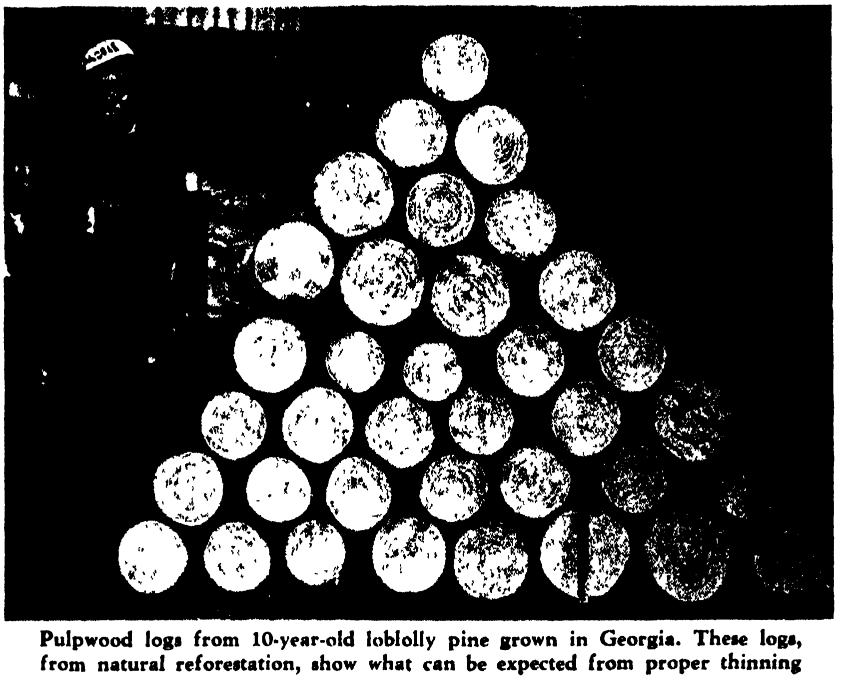
FREEDOM from ice and snow makes logging possible throughout the year, and therefore removes the heavy interest charges of the great investments in wood made necessary by conditions in colder climes.

Abundant water, from the clarified rivers or from the "ready-to-wear" artesian wells, insures ample quantities of the most necessary reagent in a paper mill.

Proximity to the Atlantic Ocean and the Gulf of Mexico insures easy access to the large consuming markets of the East, and ample rail facilities make possible close touch with the Middle West markets, each of these and, in addition, the home market now being supplied by imported newsprint.

The one point in doubt, or, rather, completely disbelieved, was the suitability of the wood of the most common tree of this southern section, the pine, for newsprint manufacture.

A preliminary experiment showed a very low resin content in pine free from heartwood, which begins to form in these trees only after they reach about twenty-five years of age. Next, a small-scale digestion of this wood by the standard sulfite process showed that it was readily pulped, giving a very light-colored product which was easily bleached. Another rough preliminary



Pulpwood logs from 10-year-old loblolly pine grown in Georgia. These logs, from natural reforestation, show what can be expected from proper thinning

WHITE PAPER

The immense pine forests of the south are penetrated by paved and hard surface highways, thus assuring low-cost yet high-speed transportation for pulpwood

experiment indicated that this wood readily adapted itself to the manufacture of groundwood.

These results were vitally interesting to only those with a most enthusiastic bias in favor of national self-containedness, and particularly in the development of a section of the country long left in neglect, whose people wring with great difficulty a bare subsistence from nature's resources.

It was necessary to provide a semi-commercial laboratory where results could be obtained on an adequate scale to be convincing as to commercial feasibility. This was made possible by four factors: The contributions amounting to about $60,000 from The Chemical Foundation, Inc., of New York City; an appropriation for two years of $20,000 each by the State of Georgia; contributions through The Industrial Committee of Savannah of a suitable building, power, fuel oil for steam, water, wood, etc.; and by the co-operation of equipment manufacturers, who gave large discounts on equipment because of the strictly research character of the undertaking.

ON January 1, 1932, the staff assembled and entered the building filled only with the soft, delicious mid winter air of Savannah. By the middle of May the equipment was completely installed and experimental work begun. The first results obtained were necessarily crude and unsatisfactory; but by constant study of the defects and constant application of the simple fundamental principles of research steady progress was shown as the weeks went by.

It was immediately evident that nothing was to be feared from the standpoint of color, in spite of the name "yellow" pine brought down from the old days of heartwood lumber. These all-sapwood pulps showed themselves brighter and lighter in color than the corresponding pulps from spruce. This was attested by numerous comparisons with spruce samples furnished by northern paper mills.

It next became important to determine what differences, if any, existed among the pulps from the five commercial varieties of pine grown in Georgia. Sulfite and groundwood pulps were made from each of these. Fibers from each were studied carefully under the microscope and measurements made. Paper runs were made of the usual commercial mixtures of sulfite and groundwood from each. No differences could be detected; and in later work in the laboratory these species have been mixed indiscriminately. (This is of particular importance in woods operation because no selective logging is required.) Preliminary bleaching tests showed that these pulps bleached easily with a low chlorine consumption.

The most startling development, however, was the fact that a large lot of wood cut for the experimental work began to show in July, 1932, marked evidence of blue stain, or sap stain, a fungus growth. Many weeks were spent in trying to overcome this blemish on the young wood which produced a darkened pulp. Dipping added expense even if thoroughly successful. Finally it was found that logs left with the bark on them showed no signs of stain until after a lapse of about three weeks. It was therefore decided to pulp and grind the wood less than three weeks after it was cut.

Apprehension as to the incomplete pulping and the prevalence of pitch proved to be perfectly groundless, the groundwood pulping beautifully and showing no sign of pitch in any of the equipment.

Varying conditions of the cooking operations and trials of various burrs on the pulpwheel resulted in constantly improved sheets of newsprint, the fibers felting excellently on the wire of the Fourdrinier.

In the Spring of 1933 a truckload of logs was delivered to the laboratory by Mr. James Fowler of Soperton, Ga. These logs were thinnings from his land on which slash pine seedlings had been set out. They were all seven years old. From them an excellent grade of newsprint was made which proved to be lighter in weight but stronger than regular newsprint when tested in comparison with paper furnished by one of the leading metropolitan dailies. On this paper was printed the first edition of a newspaper (*The Soperton News*) on material made entirely from young Georgia pine by the standard methods characteristic of the newsprint industry.

Next came the test as to the surfacing of the paper and its printing quality. The very first run of a roll of newsprint made from Georgia pine on the presses of the *Savannah Evening Press* immediately following its regular edition showed a beautiful printing with little show-through and an excellent reproduction of cuts and illustrations of all sorts.

THE most interesting experiment was that carried out on small young pine trees which had been worked for naval stores for three years and abandoned by that industry. After sawing off these logs just above the scarified portion of the trunk, high-grade newsprint was made from the unscarified part. This adds an enormous quantity of raw material standing ready and waiting for the pulp and paper manufacturer, for it is estimated that not less than thirty million cords of such wood are now standing in the South—the great bulk of which is concentrated in southeast Georgia and northern Florida.

The one remaining criticism against the excellent newsprint produced during the Summer of 1933 was that it had not yet been demonstrated that the same quality of paper made on our laboratory machine at the rate of one hundred feet per minute could be produced on a fast commercial machine.

It was a justifiable criticism and had

to be met. After a long search and many disappointments arrangements were finally completed with the Beaver Wood Fibre Company, Limited. at Thorold, Ontario, Canada, a subsidiary of the Certain-teed Products Corporation, which has a branch plant at Savannah, Georgia. Under the arrangement twenty-five tons of air-dry pulp manufactured in the laboratory, consisting of one-fourth sulfite pulp and three-fourths groundwood, were shipped to Thorold and run over a commercial paper machine at the rate of seven hundred fifty feet per minute. The pulps, mixed with two percent size and one percent clay, ran for eight and a half hours over this machine without a single break.

The experimental corn-pine plantation of Mr. Renfroe, in Georgia

The resultant paper was shipped to Georgia and distributed among the nine Georgia dailies which had contributed the funds for freight on the pulp and the returned paper. On November 20, 1933, the *Albany Herald, Athens Banner-Herald, Atlanta Constitution, Atlanta Georgian, Atlanta Journal, Brunswick News, Macon Telegraph, Savannah Morning News,* and the *Waycross Journal-Herald* appeared simultaneously on paper made altogether from young Georgia pines; and the testimony of the publishers as gathered and made public by the Associated Press on the following day showed a uniformly satisfactory behavior of the paper in the press rooms.

The paper had a marked velvety feel, required less ink for printing and was more pliable than the average commercial newsprint. In connection with this last point, we have now made in this laboratory the paper for the *Soperton News*, which was stiffer than average newsprint; the paper on which was printed the *Savannah Evening Press* test run, which was practically normal; and the paper at Thorold, which was more pliable. Experiments are now in progress to determine just how to control conditions so that any quality of newsprint desired may be produced. Preliminary indications justify the belief that this point will be readily worked out.

As a result of the data accumulated during the year from all experimental work, there was published in the special issues of the nine Georgia dailies the laboratory's estimate of cost of manufacture of newsprint in the South in a mill of 150 tons daily capacity, or 45,000 tons annual production, as follows:

Conversion Costs per Ton:	
Alum	$0.10
Color	0.06
Wrapper	0.30
Sulfur	0.60
Limestone	0.10
Clay	0.04
Wood (1.15 cords, rough)	4.60
	$5.80
Labor, inc administration	5.08
Pulpstones	0.20
Felts	0.60
Wires	0.25
Belting	0.10
Lubricants	0.08
Steam	1.50
Electric Power	4.00
Finishing	0.50
Liability Insurance	0.15
Teaming	0.15
Misc. Materials	0.15
Repair Materials	0.50
	13.26
Total Conversion Cost	$19.06
Capital Charges (based upon a total investment of $4,027,500):	
Interest at 6%	$5.37
Sinking Fund at 2%	1.79
Depreciation at 5%	4.48
Taxes and Insurance	0.25
Selling Expense	0.75
	12.64
Total Cost per Ton	$31.70

The last Georgia state legislature voted unanimously to continue for two years the appropriation of 20,000 dollars per year for maintenance and operation of the laboratory. Unfortunately this item in the appropriation bill was vetoed by the governor after the adjournment of the legislature. Almost faced with the necessity of closing the doors of the laboratory in the midst of the most important stages of the experimental work, The Chemical Foundation, Inc., appreciating the bearing of the work on national self-containedness and the vast economic interests at stake, came to the rescue with an offer to The Industrial Committee of Savannah to provide adequate funds for an enlarged experimental program for two years, and, if necessary, for a third year, provided The Committee could lease the equipment from the State of Georgia for that period.

This lease was negotiated at one dollar per year; and at the present time the work is under full way.

WHILE this work is going on in the laboratory, reforestation in young pine is going forward at a tremendous pace in Georgia. A large number of Civilian Conservation Corps camps are making a new picture of Georgia. Many miles of fire-strips are being cleared, and lookout towers erected which communicate by recently constructed telephone lines. This work and the demonstration of the value of pine fiber for newsprint by this laboratory, together with the work of the state forest service, has already brought more than five million acres of abandoned cut-over lands under intensive fire control; and on these protected areas where seed trees have been left natural reforestation is taking place on an enormous scale. Thus billions upon billions of young pines are springing up under stimulating conditions.

Meanwhile, a young Georgia pioneer, Marion Renfroe, of Brooks County, is probably making history in pointing the way to a rational utilization of the twenty-five million acres of abandoned farm land in Georgia. Believing that pines planted in cultivated ground would grow more rapidly than had previously been recorded, and, in his financial straits, hoping to take care of all expense in connection with these pines through reaping a food crop, he conceived the idea of planting pine and corn in alternating rows on his farm. For three years he has carried on this work with marked success. The corn has paid for the seedlings and their planting, and yielded an additional revenue. It is confidently expected that newsprint from his pines can be made when they are five years old.

One cannot help but be an optimist in the midst of such happenings, and, while present interests may oppose for the time being the providing of capital for a southern newsprint industry, no one can doubt that eventually the means will be found for the development of a great white paper industry in the South.

The world will be supplied with a continuous output of cheap pulp and paper; the South will reap a rich harvest from a great source of wealth which through ignorance on the part of all parties concerned has been completely overlooked; and economics will no longer be awry.

The Newer Photography

• Later Year Trends in the Development of Cameras and Films Have Revived Interest in Photography as a Serious Hobby. In Coming Months This Page Will be Devoted to the Peculiar Problems Thus Brought to the Fore, Authoritative Discussion of Which is not Available Elsewhere

WITHIN the memory of some of us who are as yet not so old, photography enjoyed a great wave of popularity as a hobby for serious-minded people. In those old days camera enthusiasts were not content simply to snap-shot their way about the country and let someone else do the developing and printing. The genuine lover of this quite new art had his own dark room, often in the cellar, in which, under the rays of a ruby light, he spent many hours enthralled with his hobby oblivious alike to the calls of his family or the wailing of baby. The sheer joy of mixing his own developer, preparing his pan of rinsing water, and then of painstakingly watching his picture "grow" beneath his hands, first on the film or plate as a negative and then on paper as an artistic finished print, was sufficient to make of him a devotee.

THEN, for a period of decades, the hobby of photography found favor among fewer and still fewer people, although the number of pictures taken increased steadily, as well as the number of picture-takers. Perhaps the steadily increasing "speed of living" had much to do with this growing lack of interest in a hobby requiring patience, but the fact remains that camera enthusiasts largely ceased the study of photography and confined their activities to the taking of snaps. The vast improvement in commercial processes for developing and printing pictures must also be held accountable, for the convenience and rapidity of "store photo finishing" cannot be discounted.

In the last few years, however, there has been observed a widespread renascence of the photographic hobby. The ruby light, in den or cellar or perhaps in the otherwise unused and darkened kitchen of a modern apartment, again has become the shrine before which literally thousands worship. What's more, the green light is making its appearance, saying "Go" to amateur photographers interested in using panchromatic film.

FOR this revival of serious interest, the camera and film industry may justifiably compliment itself. Research has done the trick—research and ingenuity in developing new camera films and lenses. For several years the trend has been toward the miniature all-purpose camera and camera manufacturers have entered this new field with a fine competitive spirit which has resulted in the availability for comparatively modest prices of cameras that take tiny pictures so perfect in detail as to make possible extreme enlargements.

The small, original "vest pocket" Kodak, by Eastman, seems to have been the fore-runner of these small cameras. This has been popular for years. Ansco produced, a few years ago, a "Memo" camera which took a still smaller picture; and E. Leitz turned out the Leica which took a "spool" of tiny pictures and had the added advantage of having interchangeable lenses. Later the Leica added a combination finder-focusing "telescope." Eastman's Pupille and Vollenda came along to take 16 pictures on an eight-exposure roll of "vest-pocket" film. The Pal-Ko, a larger camera, used roll film for convenience but boasted ground glass focusing and other innovations including the capacity for varying at will the size of pictures from $1/3$ to $2/3$ to full frame size. Follmer Graflex, of Rochester, New York and later Exakta, of German manufacture, gave, in roll-film types, practically all the conveniences to be found in any of the others.

The improvement of film and of photographic printing papers has also had much to do with the awakening of interest in photography, finer grained film emulsions being necessary before tiny negatives may be greatly enlarged and still retain their detail. These have come as a result of intensive research. For general use there was also placed on the market by Eastman, a faster and more efficient roll film under the trade mark Verichrome. This was followed sometime later by a similar film—Plenichrome—by Agfa-Ansco. Only a few months ago, Eastman produced a new roll-film that is panchromatic, the first time this principle has been available in rolls suitable for the smaller, amateur cameras. These panchromatic rolls have the advantage of also being super-sensitive, like the film used in Hollywood for three years. The combination of faster lenses, Photoflash and Photoflood lamps, and super sensitive panchromatic film is perhaps most significant because it permits untutored snapshotters to take snapshots indoors; but that fact by no means excludes the use of this possibility by advanced amateurs.

DUE, therefore, to popular demand—climaxed by a talk we recently had with several camera enthusiasts at General Electric in Schenectady—SCIENTIFIC AMERICAN will set aside space in each future issue for this reborn hobby. Details of cameras; films; lenses; filters; picture composition, developing, printing, and enlarging; and the thousand and one other problems to be encountered will be taken up. This subject will be treated primarily from the standpoint of interest and helpfulness to the advanced amateur photographer, but will also be sufficiently elementary to assist the serious beginner.

In order that this series may be developed to the greatest possible advantage, kindly tell us your problems and let us know what phases of photography you would like discussed in future.

Barnard's Black Nebulae

By HENRY NORRIS RUSSELL, Ph. D.

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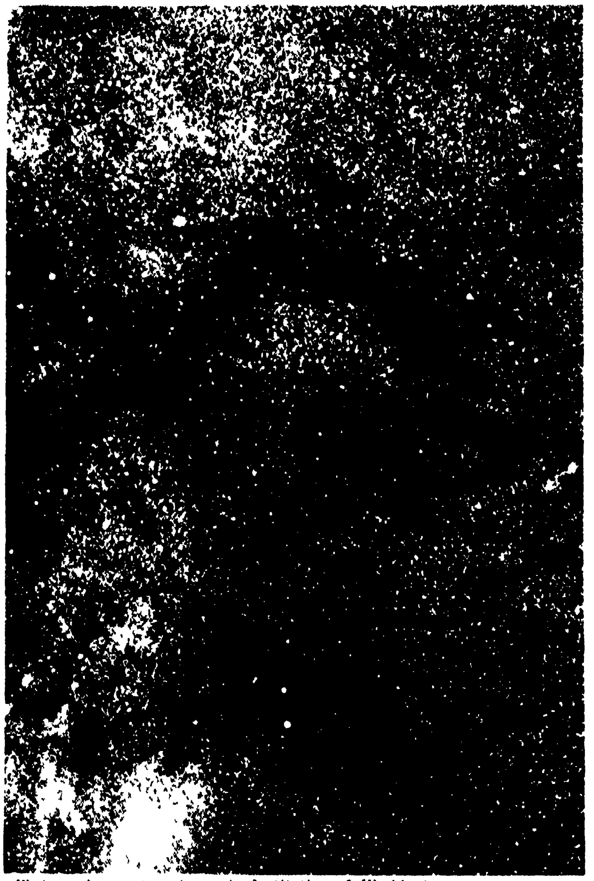
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

ON a clear summer evening—or after midnight at the present season—as we look northeastward and up into the sky, we may exclaim, "Why, there are clouds about, after all. Look at the dark strip across the Milky Way." Sure enough, in the constellation Cygnus, a narrow band lies athwart the luminous background. But this is no common cloud, it is there every night and all night; as Cygnus swings to the west and drops toward the horizon the dark region travels with it. Whatever it may be it is clearly not on earth. Moreover, a telescope, or even a good field glass, shows stars scattered here and there over the darker area, so that its cause is to be sought far away in space beyond our nearer stellar neighbors. This dark spot in Cygnus is by no means unique, though it is perhaps the most conspicuous thing of the sort which is visible in northern latitudes. In Sagittarius and Ophiuchus there are many such areas, some of them very dark but less conspicuous to the eye because they are on a fainter background. Most notable of all is a smallish region in the Southern Cross which stands out against a bright region of the Milky Way so prominently that it has been known for centuries to mariners, who call it the Coal Sack.

IT was long supposed that these dark areas represented actual gaps in the star clouds of the galaxy, through which we looked into the inky depths of empty space. The distinction of discovering their real nature belongs to the late Professor Barnard, who advanced and conclusively proved the thesis that they are produced by actual clouds of absorbing material far out in interstellar space, and of prodigious dimensions. The existence of clouds with a length and breadth of many light-years is so startling an idea that good evidence was needed, and it was amply available. Some of the obscured regions are small, black, and sharp-edged and, if interpreted as real starless regions, would demand belief in a tunnel of empty space piercing a great star cloud and pointed directly at the sun. Another, almost as black, had an irregular narrow S-shaped outline, which is even harder to explain as due to an empty region. To a long list of evidence of this sort was added the still stronger testimony of several regions where the obscured area—still void of faint and distant stars—brightened up into visible nebulosity near certain bright stars, showing clearly that the cloud could reflect light as well as absorb it, and that the bright star was actually immersed in it, and lit up the surrounding haze.



Photographs courtesy Carnegie Institution of Washington

One of Professor Barnard's photographs, showing various irregular patches of dark nebula in the constellation of Ophiuchus. Note the "S" which Professor Russell mentions. This photograph was made at Mount Wilson, with a camera-telescope having a 10-inch portrait lens of 50 inches focal length. The time of exposure was 3½ hours. The area shown is about 15 by 18 degrees in overall extent

Since Barnard's convincing presentation of the evidence no one has doubted that obscuration by opaque or partially translucent clouds is the true explanation. A reminiscence of this which has probably never been published may be of interest, especially to those to whom it recalls the personality of one of the most lovable of American men of science. Professor Barnard, at the annual meeting of the American Philosophical Society, was giving the first general public account of his investigations, and illustrating it by a long series of lantern slides of the superb quality which always characterized his photographic work. Most of them were positives, on which the regions of obscuration stood out dark on a background thickly powdered with stars. Suddenly one field appeared on the screen for which, owing to lack of time, no positive was available, and the negative was shown with dark star points on a white background. Professor Barnard, used for a lifetime to interpret both positives and negatives and usually the latter, was in the full train of his discourse and blissfully unconscious of the change. Pointing to a large unsullied area of white screen he went on, "This conspicuous dark patch . . ." The writer, familiar enough with astronomical photography to recognize the situation, heard a gasp from a very distinguished biologist in the row in front, which subsided on the whispered words, "That's a negative!"

ONCE the existence of obscuration was realized, it was found to be widespread. The great majority of the sharp details of the Milky Way arise from it. What is more, the division of the galaxy into two branches, which begins in Cygnus and extends southward past Sagittarius far below our horizon, as far as the Southern Cross, is itself recognized as due to a host of clouds—probably more or less irregularly scattered and behind another. The face of this cloud belt must be thousands of light-years long. Its widest portion lies right between us and the galactic center about which the ro-

tation of our system takes place. Could these clouds be brushed away, the southern Milky Way would look much wider and many times brighter—indeed the brilliant star clouds which adorn the southern sky in summer are probably only the edges of a far larger and perhaps brighter mass which is hidden from us.

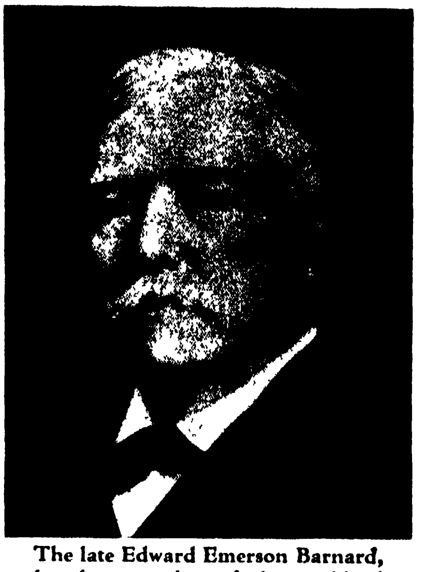
Beyond these remoter stars and on the outer fringes of the galaxy is the still vaster zone of obscuring matter. It has been known for a century that the white nebulae—spirals and spheroidal—apparently avoid low galactic latitudes. As soon as it was realized that these nebulae are themselves galaxies, though smaller than ours and far, far beyond its limits, it became clear that this avoidance must be not real but apparent, and due to the presence of obscuration upon a gigantic scale.

Obscuring clouds are therefore one of the most noteworthy features of the physical universe. Indeed, when it comes to size they far exceed anything else we know of except the galaxies themselves and, unlike the star clouds, they appear to be continuous.

OF what are these tremendously bulky bodies composed? From the start it is clear that like the clouds in our own atmosphere, they must consist of scattered fine particles—drops of liquid or grains of dust. No continuous medium, not even the thinnest gas, could extend over such enormous volumes without attaining an altogether prohibitive mass.

A cloud of gas—indeed, even if free from haze—would well-nigh blot out the stars behind it if it were thick enough, as the atmosphere at its very clearest weakens the light of the setting sun. Pannekoek, applying this hypothesis to the well-known and extensive obscuration in Taurus, found that a mass of gas sufficient to produce the observed obscuration would have a billion times the mass of the sun! All the neighboring stars would long ago have fallen into it unless they were moving much more rapidly than they actually are.

But a cloud of dust or a fog of fine drops is incomparably more opaque, pound for pound. (Compare the puff of steam from an engine with all the miles of air above our heads.) Within certain limits a pound of stuff produces a thicker cloud the finer the particles are into which it is divided, their greater number more than compensating for their smaller size. When, however, the particles become considerably smaller than the wavelength of the light, the light waves go by with less disturbance and their total stopping power diminishes, even though there are more of them. At the same time another important change occurs. Large particles which act merely by stopping light mechanically (so to speak) produce the same effect on long and short waves. A cloud or fog of such particles is gray—it weakens light of all colors to the same extent, like a neutral glass. But fine particles have a better grip on the shorter waves, which are nearer their own size and scatter them more effectively. A cloud of these, viewed by transmitted light, is yellow—for the blue and violet rays are most weakened in passing through it. (Viewed by reflected light it would look blue, for most of the light which these fine particles take out of the direct beam is scattered laterally.) For intermediate sizes the cloud would be yellowish gray, the proportion of the two influences depending on particle size. If, then, we have a partially transparent cloud, and can find out what effect it has, both in weakening and in yellowing the light of the stars which shine through it, we may arrive at some estimate of the size of the particles, and then of their total number.



The late Edward Emerson Barnard, loved personality of the world of astronomy, who was born in Nashville, grew up in poverty, worked as photographer's assistant when a boy and youth, saved and bought a small telescope, studied, made observations that attracted the attention of astronomers, won positions at Lick and Yerkes Observatories

An interesting study of this sort has just been published by Schalén of Upsala. From a series of carefully made and discussed plates of regions in Auriga, Cygnus, and Cepheus, including heavily obscured regions and apparently clear skies outside them, he finds that none of the clouds is opaque, but that the stars behind shine through with diminished brilliance. For the cloud in Auriga the absorption is 1.9 magnitudes, so that only 17 percent of the light gets through. Careful studies of spectra show that in the near ultraviolet the transmission is only four fifths as great. The cloud in Cygnus lets through some 25 percent of the light of stars behind it, that in Cepheus about 40 percent, and both of these turn the light yellowish in approximate proportion to the whole depletion.

THE theoretical effect of a cloud composed of uniform particles depends not merely on their size but on their material. Data for the calculations (which are intricate) are best available for metallic particles. On the assumption that they are composed of iron, like tiny meteorites, Schalén finds that the observed relation between the weakening and yellowing indicates a diameter of about 1/10,000 of a millimeter. Results from the different clouds are very similar.

It is then possible to calculate how many particles there must be per square centimeter in a column extending right through the cloud. If the depth of the cloud can be estimated, we then get the average distance between particles. Schalén's studies show that the effect of the Auriga cloud comes on gradually as one passes to more distant stars, and he concludes that the haze begins at a distance of only 200 light-years from us and extends for 1000 light-years. From these figures he concludes that the individual particles, tiny as they are, are about 40 meters apart. The results for the other clouds are similar.

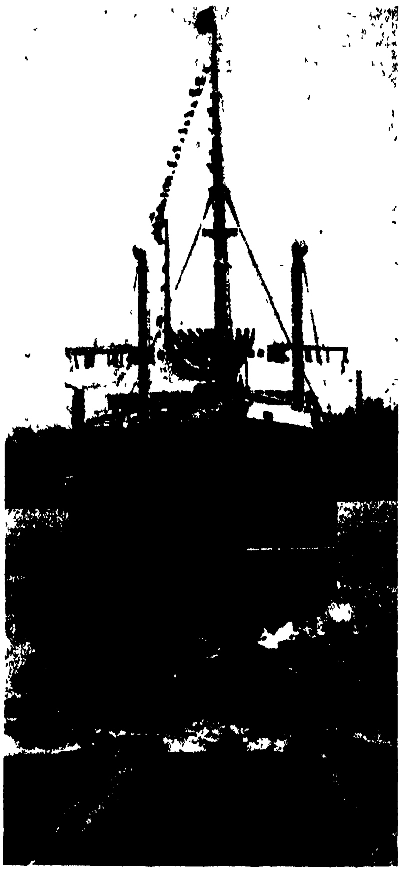
On the small scale of ordinary observation, such a region would appear to be a perfect vacuum. A cubic mile of it would contain 70,000 particles which, fused into one mass, would be less than 1/6000 of an inch in diameter, and that is all!

Though we could not detect such a cloud nearby if we were immersed in it, its total mass may be considerable. A cubic light year of it would include stuff enough to make five planets like the earth. The Auriga cloud itself has probably a volume of a couple of million cubic light-years, and the total quantity of matter required to form it would be 30 or 40 times the mass of the sun.

The values computed for the cloud, however, are minima. Particles much larger or smaller than the computed size have much less light stopping power per ton, and a mixture of these, while producing a yellowish gray cloud of the same general appearance, might be much denser.

It is really very remarkable that so much of the matter in space is condensed into luminous stars. Whether the obscuring clouds represent something that never concentrated into stars, or that has once formed part of a star and been ejected in some way, we do not yet know. When we know more about them we may be able at least to guess.—*Princeton University Observatory*, March 2, 1934.

DOWN THE



A Grace liner floats free after successfully sliding down the ways

IN launching a ship, her ponderous mass must be moved downhill, and the work must be done so smoothly that no damaging stresses shall be set up in her structure. A liner, for example, representing at the time of launching a dead weight of several thousand tons, is equivalent to a sizable skyscraper in weight; and sturdy as she will prove when water-borne, still she may be rather easily injured before launching by a momentary lack of proper support of her keel or backbone. The strength of the entire complex fabrication of steel is dependent upon the integrity of the fundamental keel. It is this fact that makes the moving of a big ship from the shore to the water a truly momentous and exacting task.

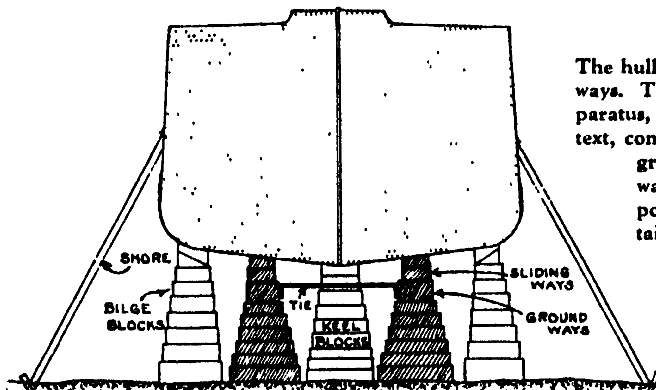
Shipyards are naturally located close to the shore of some body of water. If the ground beneath the shipway is not firm, piles are driven into the ground to stabilize it so that there will be no subsidence as a building craft increases in bulk and weight. With this precaution taken, then the keel blocks can be assembled to form a foundation on which to construct a vessel. Keel blocks are heavy, rectangular timbers that are laid one above another at intervals of three or four feet and at right angles to the length of the ship to be built. The highest stack of keel blocks is inshore and beneath the point where the stem or bow of the vessel will rise, and the blocks diminish regularly from that point to the water's edge, where the stern frame will be erected. Between these extremes will be laid the connecting keel plates, resting directly upon the keel blocks. The slope upon which the craft is thus built is designed to facilitate putting her overboard at the time of launching.

Weeks before the date set for launching, the launching ways are prepared. To a certain degree these ways must be constructed to suit the ship they serve even though much of the material can be used time and again.

The launching apparatus consists in the main of groundways, sliding ways, cradle, and poppets. The cradle and the upright timbers, called poppets, surmount the sliding ways and are so constructed that they conform to the curves of the craft's body and afford a corresponding measure of intimate support. The groundways—one on each side beneath the ship—provide two broad tracks upon which the sliding ways can move. The groundways extend out into and under the water so that the vessel will be supported until she is entirely afloat. The dimensions of the sliding ways are determined by careful calculations, because if the pressure were too much localized it might squeeze out the lubricant—several thousand pounds of which are necessary—from between the groundways and the sliding ways and make it impossible to send the craft into the water.

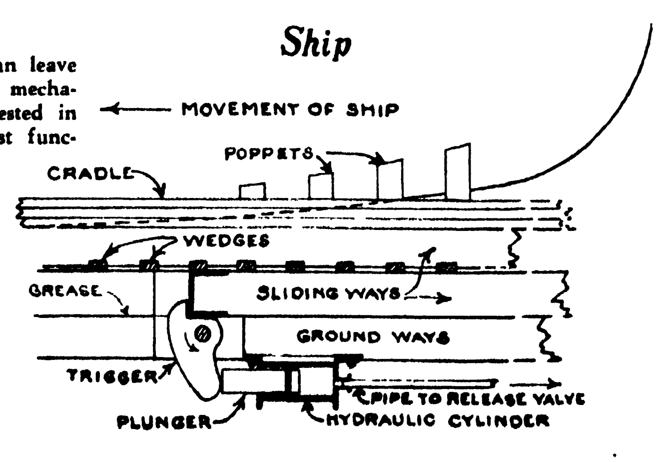
THE groundways are composed of long pieces of timber squared to about 16 inches, and which, when joined together, form a smooth bearing surface about four feet in width. The slope of the groundways corresponds with that of the keel blocks, and the groundways also slant slightly inward toward the keel of the ship. This gives the groundways the effect of a groove that serves to offset any tendency of the vessel to swerve sidewise.

In addition to the foregoing provisions, the groundways have a slight arch—technically termed "crown"



The hull of a vessel on the ways. The launching apparatus, as explained in the text, consists principally of groundways, sliding ways, cradle, and poppets. Certain details are shown here

Before a ship can leave land forever, a mechanism carefully tested in every detail, must function flawlessly so that there will be no possibility of a slip of any kind in the actual launching



*Abstracted from *The Grace Log*

WAYS

It Is a Difficult Engineering Job to Launch a Large Ship Successfully

By R. G. SKERRETT

throughout their length, to prevent the groundways from sagging and arresting the movement of the ship waterward and, perhaps, straining her: and second, to make the initial half of the run comparatively slow and then to hasten her travel during the remainder of the sliding period, which is the most critical part of the operation.

The sliding ways are next assembled upon the groundways and their lower courses are made up of single heavy timbers similar in dimensions to those of the groundways. They are carefully and strongly bound together by lacings of chain and heavy rope. On top of the lower course of each sliding way is laid another line of heavy timbers, and between the upper and the lower courses are inserted many hundreds of white-oak wedges, arranged regularly and spaced a few inches apart.

SURMOUNTING the upper course of each sliding way are the timbers constituting the cradle and the poppets, which fit snugly against the curving form of the vessel's bottom and bilges. Again lashings of chain and heavy hawsers bind these units together and link those on one side with the corresponding parts on the other side of the launching structure. The poppets and the cradle, together with the launching ways, usually float free of a craft when she is water-borne.

The general practice is to launch ships stern first. The reason for this is that the fuller form of the hull aft tends to make the vessel rise more quickly from her initial plunge than would be the case if she were sent into the water bow first, her sharp bow being a less buoyant section. This procedure makes the pivoting stress less when the burden of the ship's weight is thrown upon the forward poppets and cradle. This is the most critical moment in a launching, if the vessel has not sufficient stability in her light condition, and the poppets are unequal to the tax placed upon them, the ship may tip over and, possibly, sink. This has happened and has taken a heavy toll of life. Therefore, the forward poppets and associated parts are made especially strong.

Now let us see how the vessel to be launched is lifted from her keel blocks and her burden transferred to the launching equipment. Here is where the multitude of long and sharp oaken wedges come into play. Assuming that the time has come on the day of launching to effect this transfer, then the wedging-up operation is started at the lower or after end of the ways and continued progressively toward the bow. The wedges are driven inward with battering rams of hardwood, each ram being swung by a gang of four men. When the last of the wedges have been driven to a given distance between the two courses of the sliding ways, then the great weight of the craft has been lifted about an inch. This serves to take her weight from the keel blocks that have sustained her for many months; the blocks are then knocked out from under her. Before this transfer has been completed, safety chains have linked the sliding ways with the groundways, and at certain points on each side of the ship are placed stumpy timbers, or "dog-shores," with their lower ends resting on the earth and their upper ends canted against the sliding ways to arrest any movement. Also, before the wedging-up is started, the inshore or bow end of the sliding ways is anchored to the groundways by the powerful trigger of a hydraulically operated plunger.

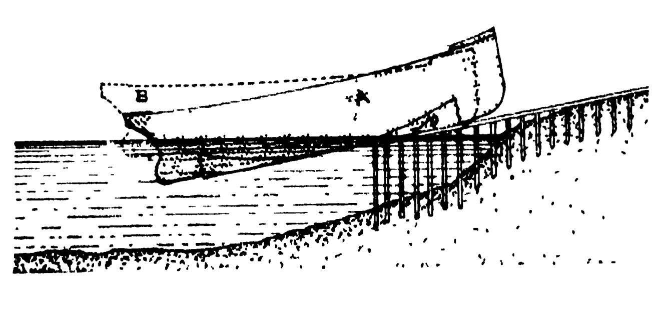
These precautions are necessary to prevent the ship from launching herself prematurely.

Poppets, cradle, and launching ways usually float free when the craft is water-borne

WITH the keel blocks removed, with all supporting shores down and out of the way, with the dog-shores disposed of, and every workman out from under the ship, the safety chains are cast loose. Then, if everything has gone as planned, the massive trigger at the bow of the vessel is the only thing that restrains her movement waterward. The hour for the launching has come, the order to trip the trigger is given, and, just as the great craft quivers an instant following her release, her sponsor smashes a ribbon-bedecked bottle upon the ship's steel stem and repeats the formula: "I christen thee . . ."

The craft gradually gathers momentum, and by the time she has gone half the length of the groundways she is moving at a pretty good clip. A few seconds later, her stern enters the water, dips, and a moment later bobs upward. By the time this movement is completed the stem also drops into the water and bows with an easy motion as if acknowledging the noisy salutes of the crowd and the fleet of tugs waiting to take hold of her and to tow her to the outfitting wharf of the yard.

Stern first because the fuller form of the hull aft tends to make the vessel rise more quickly than if launched bow first



INDUSTRY—RESEARCH

Business Management Gets the Research Point of View

By CHARLES F. KETTERING
Vice President, General Motors Corporation
General Director, General Motors Research Laboratories

TIME was, not so long ago, when industry grew by a slow process of evolution and by sporadic invention. What developments were made came as a result, not of organized study, but of the undirected efforts of individuals or small groups. Conditions changed. Mr. Kettering tells the extent of the change, how manufacturers saw, as it were, the handwriting on the wall: the imperative need for intensive scientific study of the industrial problems of development, production, and expansion. His analysis of the industrial research situation provides an object lesson for dilatory manufacturers. It also may stand, to bankers and investors in general, as a guide to the manner in which they may judge the progressiveness and foresightedness of the companies in which they would invest.

To show how the scientific research of such companies as duPont, General Electric, Westinghouse, Chrysler Motors, International Nickel, Grasselli Chemical, and of similar ones has led to momentous advances would mean simply referring the reader to past issues of this journal. To show other advances still to come, we refer to future issues in which feature articles on industrial research will be published.

—The Editor.

I AM often asked, what is research? What does it accomplish? What place does it fill in modern business? Most everybody is interested in research because they have an idea it is full of deep, dark mystery and the things they can't understand fascinate them. But man has been interested in the Delphic Oracle, witches, and medicine men until he understood their workings. Your interest in research should not come from this superstitious source.

Let me give you a modern definition. Research is an organized method of trying to find out what you are going to do after you can't do what you are doing now. That definition applies to you as an individual, to industries or to governments. That is the one biggest reason for research in General Motors.

Industrial research may also be said to be a method of keeping the customer reasonably dissatisfied with what he has. That means constant improvement and change so that the customer will be stimulated to desire the new product enough to buy it to replace the one he has You can't sell anything to anybody if he is perfectly satisfied with what he has.

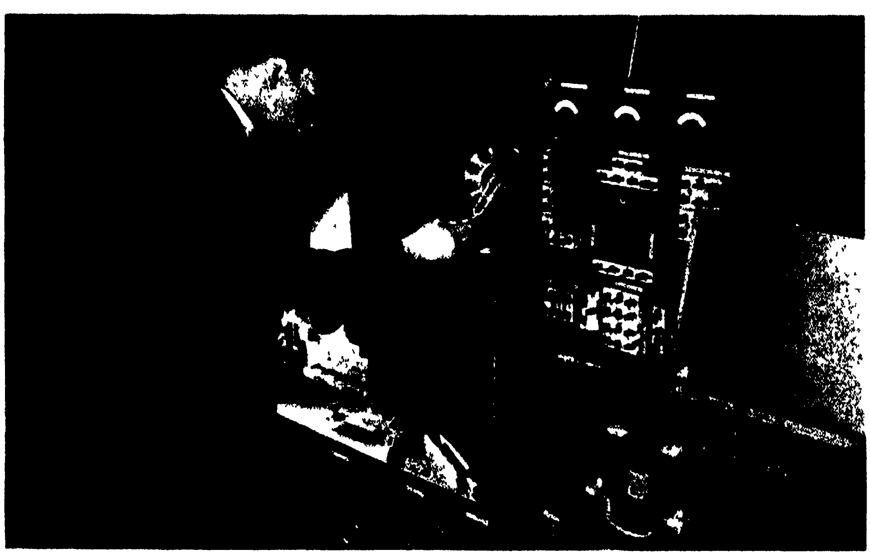
Research also always has the job of selling itself to industry and keeping itself sold. All we have to offer are ideas and they are the hardest article in the world to sell or even give away. There is one thing we are always sure of in research: When we first present an idea it is sure to be turned down. Selling an idea is a time function. From long experience, I have learned that it takes at least four years to convince the "experts" that your idea is useful.

It is how people react toward an idea without thought that determines the success or failure of any proposition in the world today it is not the thoughtful reaction. Therefore, you have to present it again and again until you get an unthoughtful favorable reaction. If I propose a new idea before any committee in the world, it will say, "It's no good." All right, that is behind me then So I present it again after analyzing why it was said to be no good. Again it is thrown into the waste basket. Again I go around after the meeting and pull it out.

So I just keep presenting it and presenting it and finally somebody will say, "Where have I seen that before? There is something to that." But it usually takes four or five years before a new idea is accepted and used. That is about the speed with which people in general accept new things.

IF you are a businessman and suddenly decide to adopt research into your organization, and go ahead and set up a committee of experts to handle the matter, then I can tell you the surest way to kill new ideas that are sprouting around your offices is to submit them to that committee. The best way to get that great, grand, epoch-making idea of yours reduced to simplest, lowest, most commonplace form of mediocrity is to get that committee to pass on it. Every single member will be able to see and will not hesitate to point out all the disadvantages that could possibly be found for your idea.

New things are too often shelved or abandoned because of objections exist-



In the difficult task of locating and measuring the loudness of noises in automobiles, General Motors research engineers use radio and acoustic standards

ing only in the mind of some man who can block the adoption of it. He has set up a purely arbitrary and absolutely false set of conditions which would never occur and which no device could satisfy. If the new thing and the old are weighed in the same balance using the same scale of weights and the new is found better, it should be adopted.

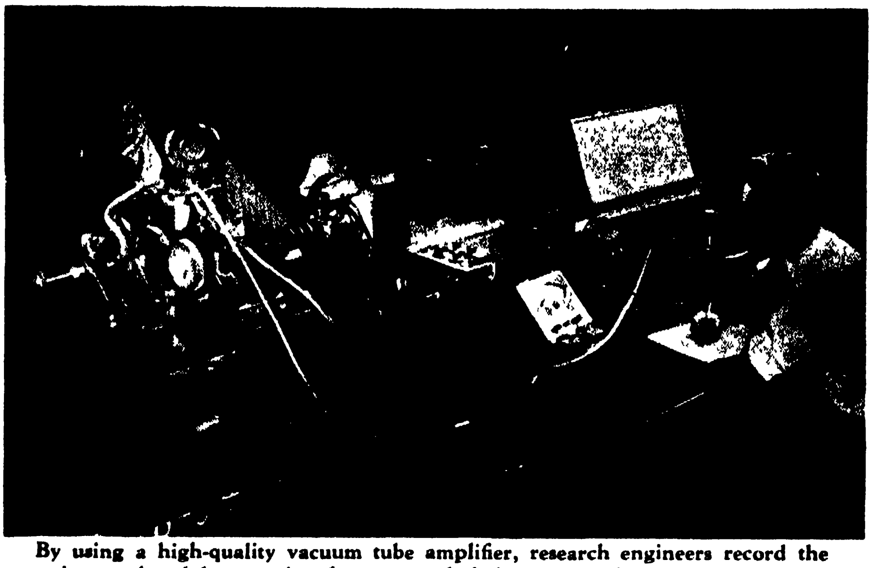
When I was first working on the self-starter we almost lost out because one man objected to moving the choke control from the front of the car where it had always been to the steering column where it could be used from the seat.

Charles F. Kettering

They told me that if put in the new position it would point out a deficiency in the starter and lead to sales resistance from the prospective purchaser. Because one man had an absurd idea on the choke, they were ready to throw out the whole self-starter even though there were no objections to the starter itself which worked just as we said it would. We finally convinced this man it would be all right to change the choke and got our starter installed.

That illustrates what I mean by false limitations and conditions. Go ahead and work out the principles first and then find ways of surmounting the minor details and limitations that come up. You will usually find that many of your first fears will have taken care of themselves.

I know of a man who cost his company a million dollars because he obstructed a proposed change that had to be made the next year anyway. Every company has men like that with little forward looking imagination but plenty of destructive negative imagination. It would be better to pay these men to get out—to keep them on the pay roll but to stop their checks if they ever came within two miles of the plant. It would



By using a high-quality vacuum tube amplifier, research engineers record the noise produced by a pair of gears, and design others for quieter operation

be cheaper in the long run and the men remaining could accomplish things. If this man were getting 10,000 dollars a year, you could pay his salary for one hundred years on the 1,000,000 dollars he cost in just one year and he certainly wouldn't live that long.

A NEW thing has enough difficulty competing with the old without imposing on it limitations which we would never think of imposing on the old one. If more time were spent on making a workable device and less on finding out why we shouldn't use it, we would have more new things appearing on the market.

We had all sorts of unexpected problems handed to us when we got really started in applying the battery starting, ignition and lighting system. The first carbon filament lamps took some time to heat up the filament, especially in cold weather. This produced a heavy drain on the battery and caused the fuses to burn out when it was impossible to obtain new ones. This was annoying and inconvenient and made it necessary that spare fuses be always in the tool box. We suggested a small circuit breaker to replace the fuses. Then it would only be necessary to throw in the breaker when it was thrown out by an overload on the circuit. After we had made up a workable device and given demonstrations, one man was still against it. He had used his imagination to picture an improbable situation in which the motorist was driving at high speed at night on a winding road in a mountainous district. What would happen if, just as he was making a sharp turn with a two thousand foot precipice over the edge of an unfenced road, the circuit breaker should be thrown out? But he didn't worry about what would happen if the fuse burned out. Many of the limiting conditions we set up are no more foolish than this man's.

The fellow who opens up their minds and overrules their objections quicker than anyone else is the sheriff. There is nothing like the sheriff to make a man think and we have had more open-mindedness in the world since 1929 than in any period before in modern times. This is true not only in business, but in government and personal relations as well. That is one reason I have been optimistic about the future. When we open up the doors and let new ideas in, things are bound to come out right in the long run. When industries, government, transportation systems and others give research a fair hearing and trial a new order, better than the old, is sure to be the result. And we are beginning to see the results of this open-mindedness everywhere. In many lines of endeavor every month more new things are given a chance to prove themselves better than the old, than were in the entire period of so-called "prosperity". That is a healthy condition.

I THINK our difficulties of the past were due, at least partially, to a wrong way of looking at things. Our bookkeeping methods were antiquated and based on conditions which were no longer true. It is now a research job, looking at things in a new light, to straighten them out.

We should not think of our good facilities as assets unless they are used—and I believe the brains of our country are our best facility. Much of our trouble during the past few years has been mistaking facilities for assets. We were fooling ourselves when we thought our big surplus of bank credit was an asset. It was an unused facility. What good are all the natural resources of the country, the surplus of wheat, cotton, steel, and other products, unless they are made available for use. Part of our trouble has been in considering

(Please turn to page 275)

Another Job for the

CODFISH

It Assisted in Building Up Our Commerce and Industry; It Can Help Stamp Out a Widespread Disease

By BION R. EAST, D.D.S.

IN Boston, there is an ancient and honored memorial—the Sacred Cod—which bears witness to the debt of gratitude America owes the codfish.

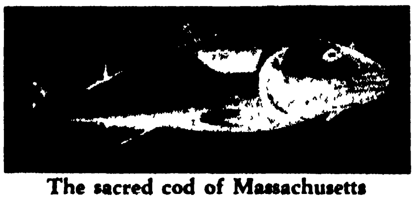
This meritorious denizen of the deep saved the New England pioneers by providing them with a much needed supply of food, and later gave them an article of export which played an important part in building up our foreign commerce, our merchant marine and, indirectly, our manufacturing industries.

Today the codfish is being called upon to do another big job—to help in stamping out rickets, a disease that afflicts many if not most of our children to some degree.

Rickets is apparently a disease of civilization. It does not seem to have been known (or, at all events, noticed) until men began to congregate in cities, to darken their skies with smoke, to use glass in their windows and, with mistaken solicitude, to confine their infants indoors during the first years of their lives. Undoubtedly, it has become more and more widespread since 1645, when it was first definitely referred to a specific disease by English physicians.

Since then it has been and still is a health menace. Dr. A. F. Hess, an outstanding authority on the disease, states that "rickets is the most common nutritional disease occurring among the children of the temperate zone. Fully three fourths of the infants in the great cities, such as New York, show rachitic signs of some degree." Other investigators show that the proportion of children showing signs of mild rickets may be as high as 50 percent in many parts of the country.

RICKETS is characterized by the improper development of the bony structures. Severe cases may develop bowed legs, pigeon breast, and other malformations. Such cases are, fortunately, rare today, as they are almost certain to receive proper medical attention. The real trouble lies with the



The sacred cod of Massachusetts

mild cases, not serious in themselves but often with serious consequences. Poor teeth subject to decay, malformed jaws, and pelves so small as to interfere with normal childbirth are among the ailments for which rickets is blamed.

The connection between rickets and civilization lies in this fact: It is now known that if a child is exposed to direct sunlight day by day all the year around, it will not have rickets. Civilized man in various ways contrives to shut himself off from the effective rays of the sun. Rickets is a direct consequence of this violation of Nature's intentions.

That sunlight was a cure for rickets was suspected as early as 1890 when it was noticed that, though infants in the tropics may be the victims of every possible error of care and feeding and the mortality rate among them is frightfully high, they rarely have rickets.

MUCH earlier than this, cod-liver oil was credited with the power of curing rickets. This evil smelling and tasting oil was originally introduced extensively in Europe for tanning leather. It was used by physicians for treating various diseases prior to 1800, and in 1826 it was being definitely prescribed in cases of rickets.

Since then, the career of cod-liver oil has been a checkered one. At times, it was believed to have properties that approximated the marvelous; at other times, it fell into disrepute and some even classed its claims for medical value as among the superstitions. Now we know that many of its alleged properties are non-existent, but it will prevent rickets.

The turning point in our knowledge of rickets occurred about ten years ago when methods of producing experimental rickets in rats were developed, thereby facilitating scientific research on that disease.

The early notions regarding the value of sunlight and cod-liver oil in the treatment of rickets were promptly verified, and it was also established that artificial ultra-violet light was effective in preventing rickets and that rickets-preventing properties could be imparted to certain foods by exposing them to the active wavelengths of light.

As soon as it was discovered that cod-liver oil really abolished rat rickets, Dr. T. F. Zucker undertook the task of ascertaining what part of the oil carried this activity. He quickly found that it was not the oil itself, but a certain material dissolved in the oil, that was the active portion. By applying suitable chemical methods a preparation 1000 times as potent as cod-liver oil itself was obtained. Later this concentrate was refined and made tasteless and odorless enough to be incorporated in foods—even as sensitive a food as milk—without altering the taste.

In the meantime, Dr. E. V. McCollum carried out a series of investigations on the rickets-preventing factor in cod-liver oil and called this factor "vitamin D."

THIS vitamin D is a thing very different from the other substances known as vitamins. All of the others occur widely distributed in plants. Plants are the primary food of animals, and any animal partaking freely of its own natural mixed plant diet will receive goodly amounts of vitamins A, B_1, B_2, C, and E. This is not so with vitamin D. In none of the ordinary food plants do we find, by our present standards, any appreciable amounts of vitamin D. The only dietary source of this substance in nature in amounts useful for our practical purposes is the fish oils. Some of it occurs in the eggs of birds, but only in comparatively small amounts. Were vitamin D as abundantly supplied in our common foods as are the other vitamins, rickets would never have become a health menace.

We now have at our disposal a number of means of combating this disease, including cod-liver oil, cod-liver oil concentrates, Viosterol, various irradiated food products, and ultra-violet ray therapy. But, in spite of this abundance of methods of meeting what is called the vitamin-D requirement, there is, according to an editorial published in the *Journal of the American Medical Association*, nearly as much rickets as ever in this country, except in certain centers where particular efforts have been made.

To avoid all the handicaps and evils resulting from having nearly 50 per-

cent of infants suffer to a greater or less extent from infantile rickets, the problem is not what to offer as preventive measures but rather *how* to get preventive measures to the thousands of infants who do not come under proper medical care or whose mothers have not been instructed in clinics how simple it is to avoid rickets.

If the proper amount of vitamin D reaches the infant population, rickets should become as rare as infantile scurvy. Not so many years ago infantile scurvy was a real problem. But, through an educational campaign which has made it a commonplace that infants should get orange juice, tomato juice, or some other form of vitamin C, scurvy, which is a vitamin-C deficiency disease, has been practically abolished.

Fruits and vegetables—the vitamin-C carriers—are relatively inexpensive, and are palatable and readily obtainable almost everywhere. Unfortunately, the same cannot be said of cod-liver oil, the vitamin-D carrier. To many, it is one of the most disagreeable substances human beings are called upon to consume. Hence it is hardly suitable as a means of combatting rickets on a nationwide scale.

On the other hand, it is practicable to distribute to the public, by the regular milk dealer, milk fortified with the purified concentrate of vitamin D from cod-liver oil. This type of milk is palatable and as long as it is supplied to the home and consumed by infants in normal amounts no precautions other than the regular feeding need be taken in order to prevent all but the unusual cases of rickets.

The concentrate as supplied to the dairies contains at least 900,000 Steenbock units per pound. At the dairy, the concentrate is finely dispersed in the milk, prior to pasteurization, in the proportions of one pound of concentrate to 6000 quarts of milk. Each quart of milk, therefore, contains 150 Steenbock units. The finished product differs from untreated milk in no way perceptible to the senses.

The potency of the concentrate itself is checked by means of biological assays before being given to the dairies. The plan for assaying the finished product as produced by the different dairies varies in different localities but the preferred plan is to have monthly assays made, unknown to the producer, in the laboratories of the local state agricultural college or other acceptable laboratories. As an added safeguard to the consumer, bio-assays are made by laboratories co-operating with the state and city control officials.

The number of Steenbock units per quart was first set at 150 because, considering the varying amounts of milk consumed by infants of different ages, it seemed to be the opinion of authorities that translating the rickets-preventing activity of cod-liver oil into vitamin-D concentrate, 150 units would protect the average child.

A large amount of work has been, and is being, done to determine the minimum amount required by the average infant. It has been demonstrated that milk containing 150 units per quart, when consumed in amounts that the average infant can take per day, healed infants with rickets in an average time of 41 days.

Another recent study has demonstrated that when 50 Steenbock units of vitamin D, prepared from cod-liver oil by the Zucker process, were fed per day in milk from November to May to a group of 48 infants, some of which showed evidence of rickets while others were normal, those that were rachitic recovered rapidly, while the non-rachitic group remained normal during the entire winter season. A control group of same age showed that over 50 percent were rachitic.

The question is sometimes raised as to whether the addition of vitamin-D concentrate to milk constitutes an adulteration. For very good reasons the laws of the various states are designed to protect such an important food as milk from harmful or fraudulent additions. The addition of vitamin D to milk by any reliable method, such as direct irradiation, special feeding of cows, or the addition of a vitamin-D concentrate, enhances the nutritional value of the milk, as opposed to the addition of an inferior substance which debases it. That this is the view of the Committee on Foods of the American Medical Association is shown by its acceptance of various brands of milk containing the concentrate, and also the following statement made by the secretary of that committee: "The Committee looks upon vitamin-D as a milk with enhanced nutritional values which is in the interest of better nutrition and the health of the public."

Experimental rats used for making tests on vitamin D in the diet

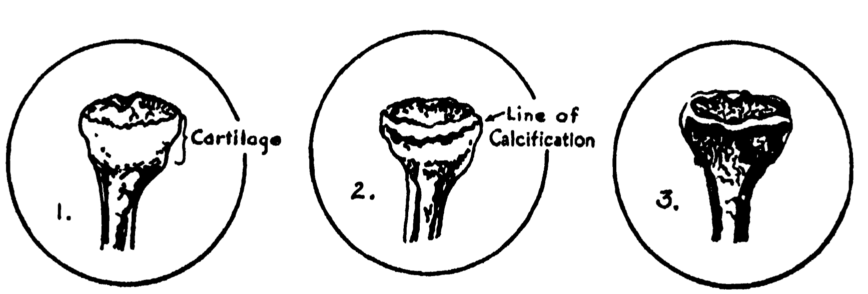
This view is supported by the fact that this type of milk is being marketed in 68 cities of 12 states, with the consent and assistance of food and drug officials.

In addition to being distributed by means of ordinary milk, the vitamin-D concentrate derived from cod-liver oil by the Zucker process is also being added to evaporated milk. This is a particularly interesting application, since evaporated milk is used by many persons whose means or location are such that they do not ordinarily receive fresh milk regularly. The fact that 1,770,338,000 pounds of evaporated milk were produced in this country in 1930 indicates the part played by this kind of milk in human nutrition, and suggests its value as a carrier of vitamin D to the public.

Bread is also being fortified with the vitamin-D concentrate and is especially useful in reaching children past the infantile age and adults. For bread the standard quantity of vitamin D added is 90 Steenbock units per pound loaf. This amount is regarded as a desirable supplement to the vitamin D supplied in the normal way through sunlight and some articles of food. As in the case of vitamin-D milk, vitamin-D bread is also carefully controlled, the product of each baker producing it being regularly checked by bio-assays.

Thus, the peculiar virtue of cod-liver oil is being made available to an ever-increasing number of persons to fill a gap now existing in the ordinary diet.

This is but one of the several plans now on foot to combat rickets along the broadest possible front. If only a part of these prove practicable and receive the support of the professions interested in public health and of the public, rickets will be eliminated as a major evil in this country.



Vitamin D "line test." Tibiae of rats fed varying amounts of vitamin D. (1) rachitic, (2) healing, (3) normal. The amount of vitamin D needed to produce a continuous line of calcification (2) in 10 days is one Steenbock unit

EARTHQUAKES

What They Are, How the Seismologist Observes Them, and Why They Are Observed

By REV. JOSEPH LYNCH, S. J.

Director of the Seismic Observatory
Fordham University, New York City

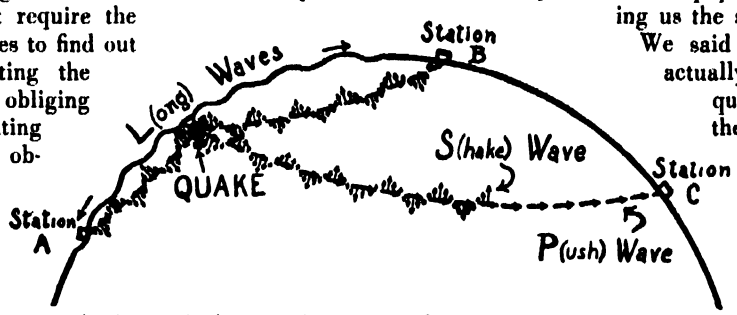
A STORY is told of a night-watchman who was watching an astronomer making some observations through a large telescope. Suddenly, in the region of the sky towards which the telescope was pointing, a star fell —a shooting star. The watchman whistled in amazement and exclaimed to the astronomer, "Gee, Mister, that was some shot!"

Our watchman gave the astronomer credit for far more than he was able to do, and in the study of earthquakes we seismologists too are often given credit for far more than we are able to do. People have often expressed surprise that we are able to record an earthquake here that is occurring thousands of miles away. The fact is, we don't record it—the earthquake is obliging enough to record itself for us. It does not require the talent of a Sherlock Holmes to find the name of a friend who has called to see us during our absence, if the caller has been thoughtful enough to leave his visiting card under our door. So it does not require the talent of a Sherlock Holmes to find out what earthquake is visiting the earth if the quake is obliging enough to leave its visiting card under our seismic observatory door—which is what every earthquake does. True, sometimes it is difficult to make out the writing on the card, but most quakes write their names sufficiently legibly for us to make them out. We have to supply the pen and ink and even the card, but the quake does the rest. On Monday, January 15th, at 3:43 A.M. New York time, a violent earthquake visited northeastern India, and some ten minutes later its visiting card was under our observatory door.

But what is the signature of a quake and how does it write its name?

Before discussing the signature of a quake let us see what an earthquake is. An earthquake may be described as a sudden slipping of a portion of the earth's crust—a readjustment of the crust tó a change of forces. A landslide is a readjustment of the crust on a small scale. A snowslide on a sloping roof is an example on a still smaller scale. When the underneath part of the snow melts, the snow begins to slide down the roof and blocks of it fall with a thud to the ground. The force holding the snow to the roof, causing it to stick to the roof, is lessened considerably and the slipping is a readjustment to this change of force—the snow moves until it finds a force which will hold it in place. A slight readjustment of the earth's crust is going on nearly all the time at Niagara. From time to time huge boulders of rock fall into the water. The softer rocks underlying the overhead rock become washed away by the spray of the falls. The supporting force is thus removed from under this overhead rock and boulders of it fall in readjustment. The rock readjusts itself to the forces present.

An earthquake is such a readjust-



Author's sketch showing three types of waves from a quake: The P, S, and L, or primary ("push"), secondary ("shake"), and long

ment to changes of pressure but a readjustment on a much larger scale. It is a readjustment taking place deep in the earth's crust, down to the depth of a hundred miles or so. The changes of pressure on such earth blocks may be due to a multiplicity of causes—erosion and deposition; tidal forces; centrifugal force (indicated by the fact that earthquakes are more or less confined to the equatorial belt), and numerous others beyond the scope of this short article. Briefly then, an earthquake is a sudden movement of a portion of the earth's crust.

This sudden movement causes the whole earth to quiver. This quiver travels through the earth as ripples through a pond, only much faster. It is not very noticeable but it has been noticed on the surface of mercury levels and still ponds. But, while not noticeable as a rule by our unaided senses, it may be made noticeable by a seismograph, the microscope of the geophysicist.

THE seismograph is the fountain pen used by the earthquake to write its signature. Its essential part is a delicately supported pendulum, something like a clock pendulum, the tip of the pendulum being equivalently the penpoint. When the earthquake occurred in India the whole earth quivered and, as the quiver passed through the ground under our delicately suspended pendulum, it made our pendulum quiver and this quivering was traced out by the pen on our paper record underneath it, giving us the signature of the quake.

We said the pendulum quivered—actually, the pendulum did not quiver. The observatory and the paper record and everything in contact with the earth quivered under the pendulum while the latter alone remained still. Hence, relative to the paper, we say the pendulum quivered, just as we say the sun rises when really it is the earth that is in motion and not the sun. Because it stays still while ground and observatory moves underneath it, the pendulum is able to trace out for us the motion of the ground and to give us the signature of the earthquake. The pendulum stays still while all around it quivers, because of its inertia—literally laziness. It will not respond to the earth's quiver for the same reason that none of us care to respond to the alarm clock in the morning. All bodies possess this inertia or laziness of motion. If a careless chauffeur starts a car suddenly, the passengers are thrown backward. Actually, they do not move, but refuse to move—they do not respond to the quick motion of the car because of their inertia, and are left behind, that is, stay still, while the car moves forward, hence they are equivalently

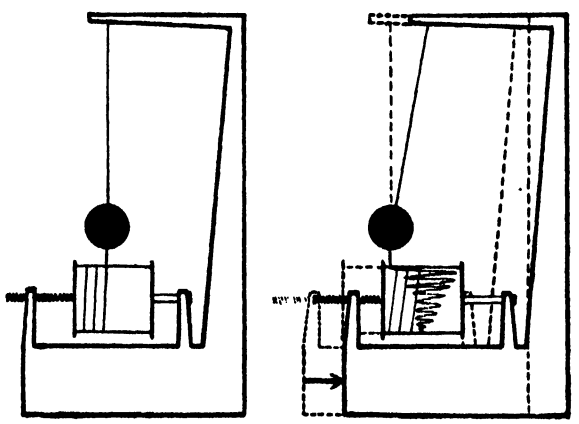
thrown backward in the car. Similarly if the chauffeur jams on the brakes suddenly, the passengers are thrown forward. Because of their inertia they refuse to have their motion stopped, so they continue forward while the car stops—hence they lurch forward in the car. We show this inertia in a personal way—we hate to go to bed, but once there we hate to get up. When the earth moves suddenly, then, under a delicately suspended pendulum, the pendulum lurches backward or forward, depending on the motion of the ground. We say it lurches—actually it stays still while the ground underneath it lurches.

This slight motion of the pendulum can be magnified in many ways: mechanically by a system of levers, electrically by winding a coil round the pendulum and setting the latter up between the poles of a strong magnet—the slight motion of the coil across the magnetic field generates a current which can be magnified in many ways. The most sensitive seismographs we have at Fordham University magnify the motion of the ground about 2000 times. This magnified motion is recorded on paper by attaching a pen to the pendulum or its lever system. To lessen friction and increase magnification, on the more sensitive instruments the motion is recorded on photographic paper by a beam of light reflected from a mirror attached to the pendulum in place of a pen. Such a seismograph set up anywhere on the globe will be set in motion by the quivering of the earth due to an earthquake and will faithfully record the latter's signature.

BUT how can we tell the signature of one quake from that of another? Just as we have the Christian name and the surname or family name in any signature, so we have, as it were, a Christian name and family name in every quake signature. The quiver that is sent out through the earth from every quake is a double quiver. The first pushes or compresses the earth ahead of it and is called a compressional quiver and travels five miles a second. The second quiver is a twist quiver, twisting or shaking the earth from side to side as it travels. It travels more slowly than the first, averaging only three miles a second. The farther an observatory is from the scene of a quake the longer will be the interval between the arrival of these two quivers, and the more drawn out will be the signature of the quake.

We recognize the signature of the quake from this double signature. If it is a long drawn out signature it is a distant quake. If the two names, that is, if the two quivers, are recorded close together it is a close quake, the exact distance being told at once by measuring carefully just how far apart the two quivers are on our record, which is kept moving at a constant rate under our pendulum, the time being marked on it automatically every second by the clock.

These two quivers or waves are due to the elasticity of the earth. The "push wave" is due to the elasticity of volume of the earth, the "shake wave" to its elasticity of shape. We have something similar in the case of a lighting bolt —an earthquake in the sky if you wish.



How quakes are recorded. *Left:* The pendulum point traces a straight line on a slowly rotating drum. *Right:* The drum shifts away from the heavy weight

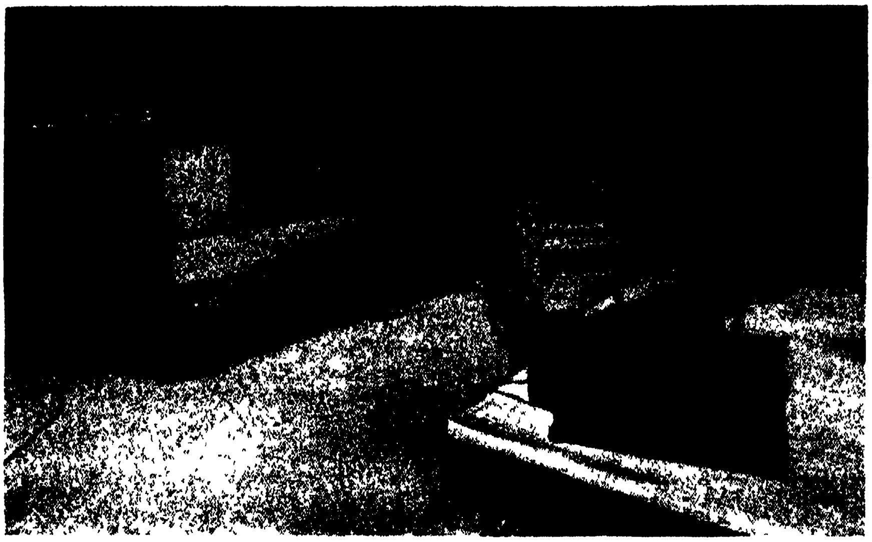
We have two distinct waves sent out—a lightning wave which we see, and a thunder wave which we hear. The lightning wave travels much faster than the thunder wave, hence we always see the lightning before we hear the thunder. In fact we can estimate the distance of the lightning bolt by the number of seconds that elapse between the arrival of the lightning and the arrival of the thunder—each second putting the bolt a fifth of a mile away. In a similar way we can estimate the distance of an earthquake from a seismograph by measuring the number of seconds that elapse between the arrival of the "push wave" or primary wave and the arrival of the "shake wave" or secondary wave. A set of tables has been compiled giving the distance of the quake for each time interval in seconds. In addition to the push and shake waves, a third wave, a combination of the two, travels around the outside of the earth and arrives much later. It is not necessary for the computation of the quake's distance but it acts as a useful check since its speed is likewise known.

I can imagine your saying that this explains how we can tell the distance of a quake from its signature, but it does not tell us just where the quake is. The long drawn out signature of the Indian quake could tell us it was a quake 7600 miles away, but could not tell us whether it were in India or Chile because both are about 7600 miles away. How can we tell the direction from the signature? If we had only one seismograph we could not tell the direction, but we have a whole family of seismographs and the quake obligingly writes its name under each one. Three seismographs of any one type are required if we are to be able to tell not only the distance but also the direction of the quake from its signature. One seismograph is set so as to respond only to motions from the north or south, another seismograph is set so as to respond only to motions from the east or west, and a third seismograph has the weight of its pendulum suspended by a coiled spring so as to respond only to an upward push or a downward pull of the ground. It tells us whether the ground is first pushed up or pulled down under it as a result of the quake. If we piece together all three motions the first two tell us whether the quake is, say, from the north-east or the south-west. The third or vertical instrument tells us whether the ground was being pushed from the north-east or pulled from the south-west.

Hence with three instruments we can tell both distance and direction. Moreover, we have the addresses of nearly all quakes that are likely to call at any time and if we have the distance and probable direction of a quake that has called we can usually say, "That is that South Mexican quake calling again" or "that is that Aleutian Island quake calling again." Both of these were frequent callers during the past year; nine calling from the Aleutian Islands and six from South Mexico.

OFTEN, of course, the signature of the quake is a poor one—very illegible. Legible enough to tell us the distance but not the direction. In that case we consult two other stations and, knowing the distance of the quake from three stations, we draw three circles on our globe with the three stations as centers and the three distances as radii. The three circles can intersect only in one point and that point is the scene of the quake.

We said we had a whole family of seismographs—at Fordham University we have eight in operation. Three of these are very sensitive and magnify about 2000 times. For a very large quake, however, they are sometimes too sensitive and magnify the motion too much. So we have a pair of less sensitive instruments to give us the signatures of the larger quakes. Then again we sometimes have little baby quakes



In a vault, 16 feet below the surface at Fordham University, in New York, eight seismographs take the pulse of the earth when her heart begins palpitating

that are felt only locally. They are not only much feebler than the larger quakes but they quiver more rapidly—the baby takes shorter and quicker steps than its parents, and we have to have a more rapidly quivering pendulum to be able to write down these quick baby steps. We have two so-called short-period seismographs for near and baby quakes.

With regard to the frequency of quakes: During the past ten months nearly 300 quakes called on us—more than one a day. Of these, about 50 left signatures sufficiently legible for us to recognize and locate definitely. Few of these did any serious damage until the last Indian quake, which destroyed about 5000 people.

BUT of what practical use is an earthquake observatory? The new seismology, or the scientific study of earthquakes, since its birth around 1895, has busied itself mainly with four lines of investigation: What can seismology tell us about the nature of the earth's interior; how can seismology be used in prospecting for oil, coal, and such materials; how can we construct buildings that will withstand earthquake shocks, and, lastly, how can we foretell when an earthquake is due in any given locality?

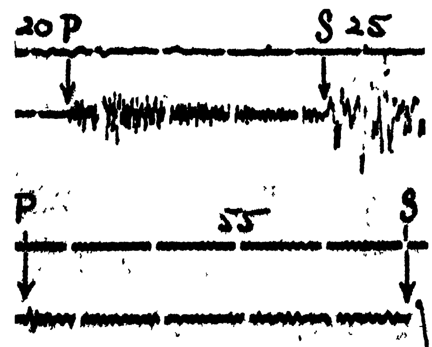
Much progress has been made along all four lines. We have now a fairly accurate picture of the internal structure of the earth. Seismology has, as it were, let down its camera into the interior of the earth and photographed it for us, and we find it to be a solid sphere with a dense core probably of nickel or iron, starting about half way down like the core of a baseball. For many years the interior of the earth was thought to be liquid, but a liquid core does not fit in with the findings of seismology. The existence of the core is deduced from the fact that earthquake waves are refracted or bent as they pass through the earth, much as light waves are refracted as they pass through glass or water. From the amount of refraction we can argue to the depth of the refracting surface. The twist or shake or secondary wave is due to the elasticity of shape and can exist only in a medium which has a shape of its own; namely, a solid. Since the twist wave passes through the core, we conclude that the core is solid, since only a solid can transmit a twist wave.

With regard to the prediction of earthquakes, seismology has not yet reached the stage where we can foretell quakes ahead of time, but investigations in this direction which are being carried out in Japan give hope that the time is not far distant when such prediction will be possible. It has been noticed that in earthquake regions the earth shows evidence of tilt or gradual rising for some years before the quake occurs, much as the inner tube of a tire or the bladder of a football rises gradually through a tear in the cover before finally bursting. The tilt of the ground is being carefully observed and measured, and it is hoped that it will finally give the clue to the forecasting of earthquakes.

Seismology has been used successfully in prospecting for oil and coal. An artificial earthquake is set up in the ground to be prospected by setting off an explosive in the ground, portable seismographs being set up at known distances from the center of this artificial quake. The time of the arrival of the earthquake waves from the artificial quake is carefully observed on these instruments and this time gives a clue to the structure of the ground through which the waves have passed.

In the matter of building, much has been accomplished. The data on seismology given to the engineers have enabled the latter to revise the building codes in California and Japan considerably, and these codes offer a basis for safer construction in other earthquake regions. According to the late Professor Suyehiro, even in the violent Japanese earthquake, buildings which had been designed to resist a horizontal force of one tenth of their weight successfully withstood the shock. The increased building cost necessary to provide this resistance to earthquake shock has been carefully figured and is ridiculously small—about 15 percent. Quakes can, with a little forethought and a little extra trouble in building construction, be effectively provided against.

Seismology has also shed light on earthquake insurance. The late Doctor Freeman has shown that earthquake risk has in the past been enormously exaggerated. Even in the most disastrous quakes, the actual damage has always been confined to a comparatively small area and careful analysis reveals the assuring fact that the actual loss seldom exceeds five percent of the structural value. Were the full facts made clear, both to the public and to the insurance companies, each would be better served; premiums would be reduced, helping the insured, and insurance would be more generally taken out, helping the companies.



Two typical examples of earthquake records, showing, in either case, the P and S waves. The numerals refer to seconds of time (note breaks in line). Upper lines show no quakes, being from previous turn of drum

IN conclusion we might say that earthquakes are nature's safety-valve, wisely arranged by Divine Providence for our greater protection. They come for the most part in uninhabited regions, but if at times they cause sorrow and hardship, perhaps those beautiful lines of Father Tabb will come to our aid in viewing them in the light of blessings in disguise:

"My life is but a weaving between my God and me,
I offer Him the threads, He weaveth steadily.
Full oft He weaveth sorrow and I in foolish pride
Forget He sees the upper and I the under side."

Some members of the Indianapolis Amateur Astronomers' Association

Right: A photograph of a part of the constellation of Cygnus, made by V. E. Maier, Secretary of the Association (1306 Parker Ave.) with a 4-inch portrait lens. A dark nebula, Herschel's famous "hole in the sky," shows in part in the upper right hand corner

Above: A 15-inch reflecting telescope made by Carl Turner, with a mounting designed to take, ultimately, a 30-inch mirror. Total weight is 5500 pounds. It is driven by an electric motor, through a worm gear of bronze which weighs 700 pounds. Polar axis shaft 5½". Turner (insert in corner) is an automotive engineer

R. E. Parker and his six-inch reflecting telescope, made in 1926 from instructions by R. W. Porter, published in the *Scientific American* and in the book "Amateur Telescope Making"

Samuel S. Waters, President of the Association, with his ball bearing mounted telescope. Mahogany tube

Left: Wm. H. Jordan and his 9-inch reflector

Amateur Astronomers' Activities in Indianapolis

SINCE this magazine revived and expanded the slumbering old hobby of amateur telescope making, in 1926, more than 5000 of its readers have found themselves so intrigued by its fascination that they have made their own telescopes, while in several cities—Los Angeles, Chicago, Pittsburgh, Tacoma, Dayton, Buffalo, Cincinnati and others—local clubs of amateur telescope makers and astronomers have been formed. One of these is the Indianapolis Amateur Astronomers' Association, and some of its activities are shown pictorially above. An interesting side light on this hobby is the fact that the comparable clubs from Chicago and Cincinnati often journey and meet with the Indianapolis club.

SUNDIALS AND THEIR CONSTRUCTION—IV

Declining and Reclining Dials

By R. NEWTON MAYALL
Landscape Architect

and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory

PREVIOUS articles have described the construction of the horizontal, direct vertical, equatorial, and polar dials. All of these dials are simply constructed and their computation is not difficult. Each also faces one of the cardinal points of the compass and therefore these dials are not applicable to surfaces which do not face the cardinal points. Recourse must therefore be had to the declining dial, the computation for which is more complicated than for the preceding dials. The construction of the declining dial, by the geometric method, is easily accomplished and should not present any problem to the reader.

There are four types of vertical declining dials: Those facing the south and declining respectively toward the east or west (1 and 2); and those facing the north and declining respectively toward the east or west (3 and 4). The construction of each dial is similar, and only one need be described here. This will be the south vertical dial declining west.

THE plane of this dial is perpendicular to the plane of the horizon, and it does not face any of the cardinal points. Unlike the preceding dials, two things must be known before the hour lines can be constructed: first, the latitude of the place and, second, the declination of the dial or the declination of the plane upon which the dial is to be placed. (The declination of the plane may be found by one of the methods described in the March article.) Figure 3 shows the construction of the hour lines for a dial in latitude 40°30′, declining west 28°.

The gnomon is perpendicular to the face of the dial.

The style points to the celestial pole.

The substyle is to be determined. (The substyle is not the 12 o'clock line, in this type of dial.)

The height of the style is to be determined.

TO find the substyle line, draw the horizontal line *ABC* (Figure 1). From *B* let fall a perpendicular line *BD*, which will be the meridian or 12 o'clock line.

Draw the line *BE* so that the angle

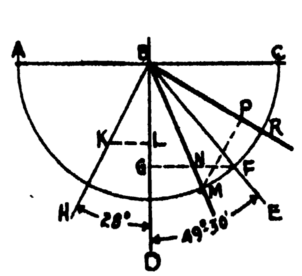


FIGURE 1

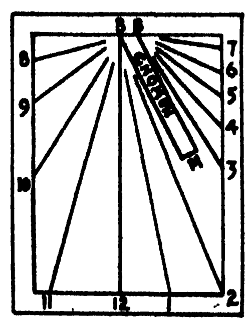


FIGURE 2

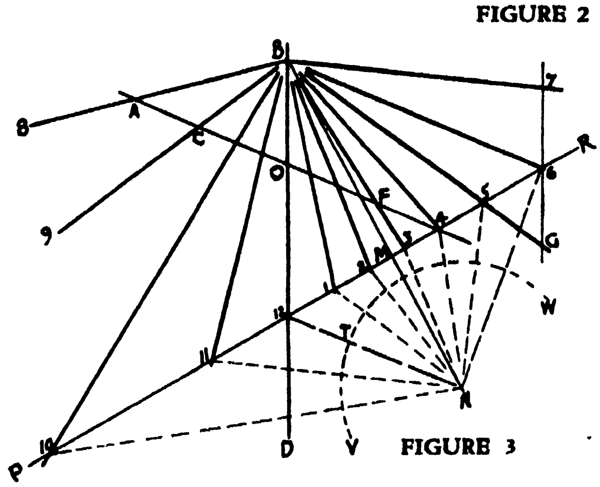


FIGURE 3

DBE is equal to the complement of the latitude, which in this case is 49°30′ (90°—40°30′=49°30′).

With *B* as a center and any convenient radius draw the arc *AC*, which cuts the line *BE* at *F*. From *F* draw a line perpendicular to *BD* at *G*.

From *B* draw *BH*, making the angle *HBD* equal to the declination of the plane, which in this case is 28°.

Make *BK* equal to *GF*, and from *K* draw *KL* perpendicular to *BD*. Then on *GF* make *GN* equal to *KL*.

Draw a line from *B* through *N*, cutting the arc *AC* at *M*. This line is the substyle line upon which the gnomon must be placed, perpendicular to the face of the dial.

The substyle line must fall among the afternoon hours, if the dial declines west; among the morning hours if the dial declines east.

To find the height of the style (Figure 1):

With *N* as a center and the radius *BL*, describe an arc cutting the arc *AC* at *R*.

Draw a line from *B* through the point *R*.

The line *BR* is the style, and the angle *RBM* is the height of the style. (The style must make an angle with the face of the dial equal to the angle *RBM*.)

TO find the hour lines (Figure 3):

In this figure the lines *BD* and *BM* have been reproduced from Figure 1.

In Figure 1 the line *MP* is perpendicular to *BR*.

In Figure 3 the line *MB* has been produced, so that *MN* is equal to *MP* (Figure 1).

With *N* as a center and any convenient radius, describe the arc *VW*; and at *M* draw the line *PR* perpendicular to *BM*, cutting *BD* at 12.

Now draw *N*12, cutting *VW* at *T*.

Beginning at *T* divide the arc *VW* into equal spaces of 15 degrees each. Draw lines through these divisions until they cut the line *PR* at 10, 11, 12, and so on.

From *B* draw lines through the points 10, 11, 12, and so on. These lines will be the required hour lines.

To obtain the hours after 6 P.M., draw a line through 6 (*B*6 is the 6 o'clock line) parallel to *BD*, and cutting *B*5 at *G*. For the 7 P.M. line make the distance 67 equal to *G*6. The 8 P.M. line may be obtained in the same manner.

To obtain the hours before 10 A.M., draw a line through any point on *BD*, such as *O*, parallel to *B*6 (the 6 o'clock line). This line cuts *B*3 at *F*, and *B*4

at 4. From *O* lay off the distance *OC* equal to *OF*, and *OA* equal to *O*4. Lines drawn from *B* through the points *C* and *A* will give the 9 A.M. and 8 A.M. lines.

Figure 2 shows the lines constructed in Figure 3 applied to the dial plate, in their proper position, and the way in which they should be numbered.

The number of hour lines and the length of time the sun shines upon this dial depends upon its declination from the meridian. The 12 o'clock line is always a vertical line.

In setting the dial it is essential that the plane upon which it is to be placed be vertical. The declination of the plane having previously been carefully determined, attach the dial securely in place.

The hour lines constructed for a south vertical dial declining west will also serve for a south dial declining east, a north dial declining west and a north dial declining east, if each dial has the same declination and latitude. This will easily be seen if the hour lines have been drawn on transparent paper. Thus, Figure 2 represents the hour lines for a south vertical dial declining west 28°. If the figure is looked at from the rear, the hour lines for a south dial declining east 28° will be seen; if the figure is turned upside down, the hour lines will be those for a north dial declining west 28°; and the reverse side of the figure, when turned upside down, will show the hour lines for a north dial declining east 28°. It must be remembered that the morning hours of a dial declining west will become the afternoon hours of a dial declining east; and that the substile of a dial declining west will fall among the afternoon hours. But the substile of a dial declining east will fall among the morning hours. Therefore, while making one dial, the hour lines for all four declining dials have been constructed.

Direct reclining dials are so called because their planes face the cardinal points of the compass, and as you stand before them they lean from you (or recline from the zenith). A plumb line is perpendicular to the plane of the horizon and if extended, it would cut the zenith at any given place. The reclination of a dial or plane is that angle, measured in degrees, formed by the intersection of the dial or plane with a plumb line. Two dials of this type—the polar dial and the equatorial dial—have previously been described.

There are four types of direct reclining dials: the direct south, north, east, and west dials. These may be divided into two groups—the north-south and east-west. Before the hour lines for these dials can be computed the dials must be referred to that position at which they *would* become horizontal or vertical dials. This is called "reducing to a new latitude." The method of reduction is but a simple mathematical operation.

Direct north and south reclining dials must be reduced to new latitudes, where they will become horizontal dials. Determine the reclination of the plane upon which the dial is to be inscribed, and proceed as follows:

In the case of the direct south recliner, if the reclination of the dial is *less* than the *complement* of the *latitude*, the new latitude = complement of the latitude *minus* the reclination. If the reclination is *equal* to the complement of the latitude, the dial will be a *polar* dial. If the reclination of the dial is *greater* than the *complement* of the *latitude*, the new latitude = *reclination minus* the complement of the latitude.

In the direct north recliner, if the reclination is *less* than the *latitude*, the new latitude = complement of the latitude *added* to the reclination. If the reclination is *equal* to the latitude, the dial will be an *equatorial* dial. If the reclination is *greater* than the latitude, the new latitude = 180° *minus* (reclination *added* to complement of the latitude).

From the above formulas, it will be noticed that, in each case, the style points to the celestial pole; the substyle is the 12 o'clock line and lies in the plane of the meridian; the height of the style is equal to the new latitude.

The construction of the hour lines for these two dials is the same as that for a horizontal dial.

Direct east and west reclining dials (Figure 4) can be reduced to latitudes at which they will be south vertical declining dials. This is done very simply by the following formula: The complement of the latitude of the place is equal to the new latitude, wherein the dial becomes a south vertical declining dial; and the complement of the reclination is equal to the declination of the south vertical dial, in the new latitude. (An east recliner will have a west declination, in the new latitude, and vice versa.)

Having found the new latitude and the declination of the dial in that latitude, proceed to lay out the hour lines for a south vertical declining dial, according to the construction previously described in this article. For example, let it be required to construct an east dial reclining 35°, in latitude 39° north.

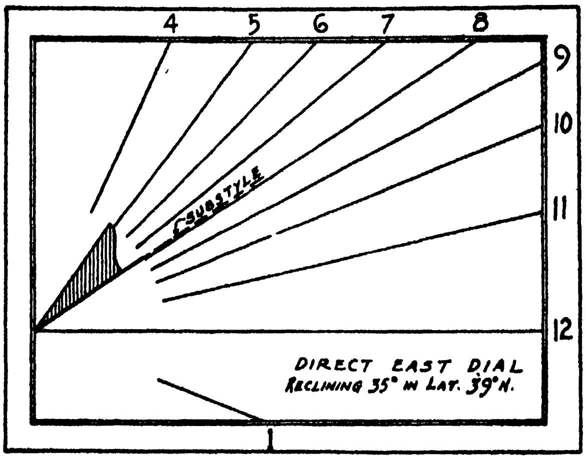


FIGURE 4: Hour lines constructed for an east reclining dial, showing how they should be numbered. The line for 12 o'clock is at the base of the dial and the center is at the left. A west dial having the same reclination will be seen, if looked at from the reverse side, and the center of the dial will then be at the right

From the formula given above, this reclining dial will become a vertical dial in latitude 51° (90°—39° = 51°), and decline in that latitude 55° west (90°—35° = 55°).

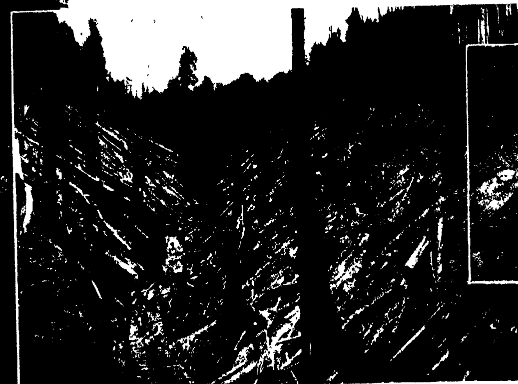
Figure 4 shows the hour lines constructed for this dial, and the way in which they should be numbered. The 12 o'clock line is at the base of the dial. The center of the dial, on the east recliner, is at the left; and at the right on the west recliner.

If the hour lines are drawn on transparent paper, the reverse side will show the hour lines for a west dial reclining 35° in latitude 39° north. If Figure 4 is turned so that the 12 o'clock line is perpendicular, the reader will then see a dial which is a south vertical declining 55° west in latitude 51°, the morning hours then becoming the afternoon hours.

Therefore, in each of these dials, the gnomon is perpendicular to the face of the dial; the style points to the celestial pole; the substyle is to be determined (the substyle is not the 12 o'clock line, in this type of dial); and the height of the style is to be determined.

Care must be used to set the dial in the position for which it was computed. The 12 o'clock line will be near the bottom of the dial and must lie in the plane of the meridian and parallel to the horizon.

Seldom will it be necessary to lay out the hour lines for sundials other than those described in this and the foregoing articles. The following articles will describe various ways of making the sundial more useful, by the addition of numbers and lines on the dial plate.

Fire and intensive logging have converted these once forested slopes to a scene of desolation. Forestry genetics may make possible a mature growth in 25 years of sturdy trees to replace those wiped out by conflagrations and greed of man

Photo by U S Forest Service

Tree seedlings being carried by pack horse into mountain region for planting in locations where they are needed

Administration building and part of the nurseries of the Institute of Forest Genetics, where experiments are being conducted with the aim of improving the quality of growing timber and at the same time increasing the rate of tree growth

Breeding Better Trees

SEEDS and pollen from selected trees of the world have been brought together in the greatest birth-control experiment ever attempted. America is rapidly but somewhat belatedly learning its lesson from the ruthlessness with which our forests have been depleted without thought for the future, and a noteworthy attempt to rectify past errors is being made at the Institute of Forest Genetics, Placerville, California. Here, under the supervision of Lloyd Austin, director of the Institute, experiments are under way which are directly aimed at increasing the rate of growth of various species of trees and, at the same time, improving the breed so that the resulting lumber may be more economically used.

As pointed out in the article on page 234 of this issue, paper production is one of the uses to which vast quantities of lumber are diverted. The experiments at the Institute may have a definite bearing not only upon the new source of pulp-wood mentioned in the article referred to, but also upon other types of trees which are potentially valuable for pulp.

Measuring tree growth in the nursery. Height, diameter, and branching are all recorded. In one progeny test, 110,000 measurements were taken and recorded

Pinus montezumae, rough branched pine (Mexico) thrives in snow

At the present time 60 years are required to grow the average forest tree to saw-log size. If this growing time can be cut in two—if usable timber can be produced in about 25 years—we can save our forests from becoming completely denuded. Therefore, the workers at the Institute of Forest Genetics have searched the world for worthy parents from which to breed hybrid trees and thus select and promote desirable characteristics of rapid growth as well as efficient foliage with few branches and a sturdy root system to withstand storms. Speed of growth is the first consideration, but the workers have not lost sight of other features that will make the wood applicable to many uses.

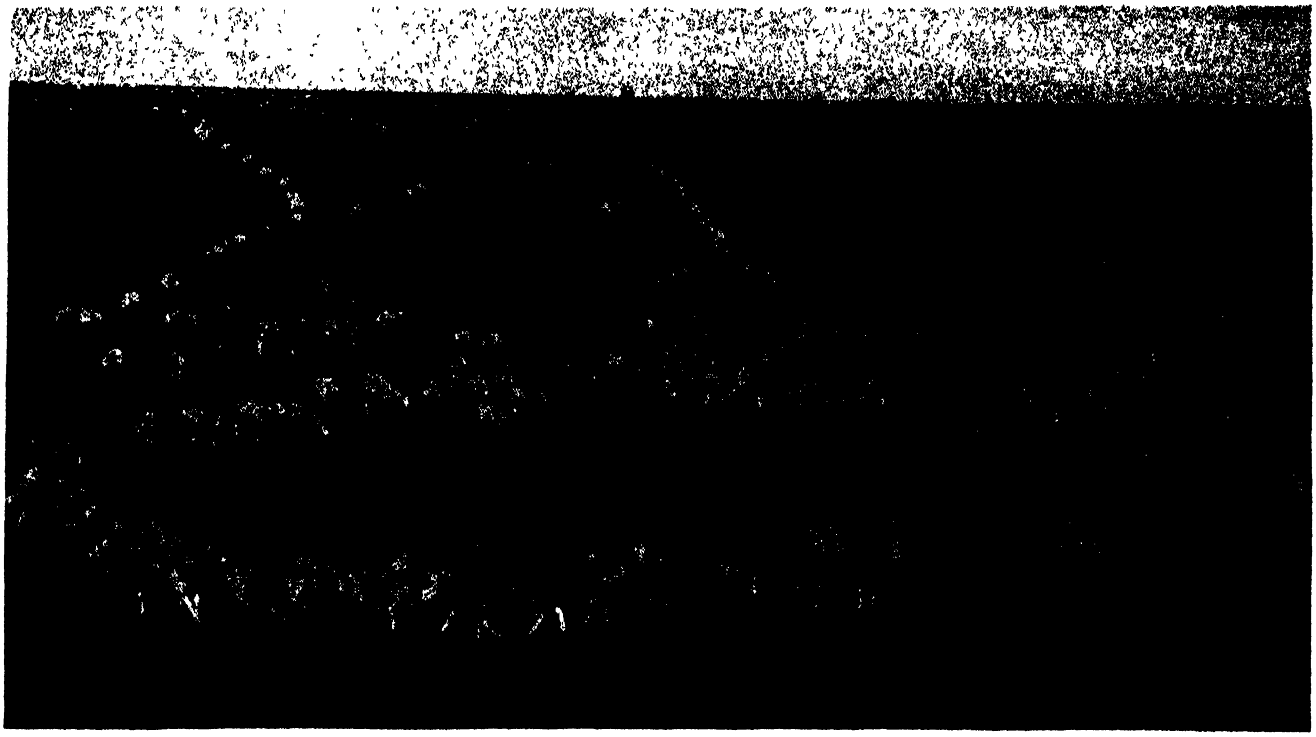
Age of a tree is found by counting rings on a core taken with a borer

Taking a leaf from other plant breeders, the men at the Institute leave nothing to chance in their work. Pollination is carefully controlled, the female flowers of an experimental tree being protected by bags during the pollination time, so that chance pollination cannot take place. At the proper time selected pollen is injected into the flower, possibly from a tree that grew on the other side of the world, and the resulting seed is planted and carefully nurtured.

Throughout the early period of growth, accurate measurements are taken and a complete record kept of all observations. Thus the tree breeders keep a check on results and know at all times how an experiment is progressing.

What will be the super-tree of America, that can withstand the rigors of winter, the ravages of insect pests, the blighting diseases, and the heat and dryness of torrid summers? It is still too early to say, but the work of this Institute is a step toward the solution of a pressing problem, and one which holds promise of brilliant results.

Young trees are tested for hardiness in this field plantation of the Institute, where the temperature in winter frequently ranges down to zero and often below



Sheep at a dew pond, the building of which is still shrouded in mystery. Many such ponds are to be found on the downs of England. This photograph was taken during a severe heat wave, when the pond level remained constant

Dew Ponds

How Water is Obtained on the Bleak Downs of England Where There are No Springs or Streams

IN England, where inscrutable relics of pre-historic man remain to intrigue the imagination of present-day civilization, the dew pond remains as one usable invention, the origin of which is shrouded in the mists of antiquity. What are dew ponds, and what is the source of the water with which they are filled even in the driest of weather? Photographs recently published in *The Illustrated London News*, and reprinted here by courtesy of that periodical, have revived interest in an often disputed question. The following paragraphs accompanied the photographs:

"The mystery of the dew-ponds still remains; and men are wondering today, as they wondered centuries ago, how and whence the water comes that fills those lonely hollows on the highest hills. On the bleakest ridges of the Sussex Downs, far from shade of tree or protecting copse, where no streams have ever flowed, where no marsh has ever been, there, on those arid uplands, are found the dew ponds with the waters that never fail. Condensation of the moisture of the atmosphere it may be, cooling into drops that merge into the pond in the chill night air, and so counteracting the evaporation under the summer sun. Go when we will, at all seasons of the year, there is water for the cattle or the sheep that roam the green downlands.

"The secret of the making of these ponds is known to but a few. The lime and flint to form the saucer-shaped bed, the layer of straw beneath the covering of clay, the final concrete surface, are all wrought with experience and craft that are a heritage from the past, and then left to dry. Once the pond has filled, though the clouds withdraw their shelter and no rains fall, though the torrid sun pour down its relentless heat by day, there will be the water for the cattle to drink.

"IT would be wrong to say that there are no dry dew-ponds, for they are often to be seen about the Downs. But the reason is not far to seek. Once the bed of the pond is damaged, so that the water can trickle through, the pond naturally fails. That is why many of these dew ponds are fenced, so that the heavier beasts cannot tread the surface, and only sheep are allowed access.

"On the heights of Cissbury, not far from Worthing, may be seen the dry, shallow bed of a pond that has been broken up; and the sheep, in their wandering about the Downs, visit this spot repeatedly, as though an instinct led them where water once had been. A mile northward across the same downlands at Chanctonbury, and not far from the well-known Chanctonbury Ring, there is a pond which cattle are allowed to use at will; and through the heat of summer they may be seen standing knee-deep in the water; but already the concrete surface is so damaged that it can be but a little while before those much-needed waters fail.

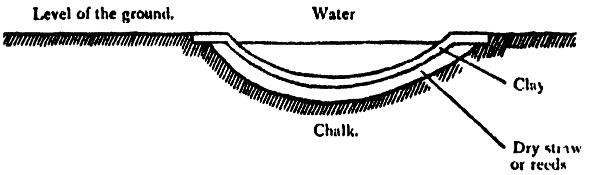
"Only a few new ponds have been constructed of recent years along the Sussex Downs; but westward, on the Marlborough and Wiltshire Hills, some have been added to the already existing number. There is no record of the making of the first dew pond, and the name of the discoverer of the secret has passed from human knowledge; but early dwellers in our land had their cave dwellings on the hills. On the highest portion of the Downs may still be seen the hollows where their pit-homes were excavated, and it may be that these prehistoric folk learned the secret of securing the water they needed for themselves and their cattle on these exposed heights; and that from them, down a long succession of shepherds and hill-dwellers, there has come to us today the secret of the making of the 'mist-pools' of the hills."

Arthur John Hubbard, M.D., and George Hubbard, F.S.A., F.R.I.B.A., in their book "Neolithic Dew-Ponds and Cattleways" (1907), give the following complete description of a dew pond:

"We are not aware that the thermodynamics of a dew pond have ever been elucidated, and it is evident that this cannot be done until the construction of such a pond is understood. There is in this country [England] at least one wandering gang of men (analogous to the medieval bands of bell-founders, masons, and so forth) who will construct for the modern farmer a pond which, in any suitable situation in a sufficiently dry soil, will always contain water. This water is not derived from springs or rainfall, and is speedily lost if even the smallest rivulet is allowed to flow into the pond.

"THE gang of dew-pond makers commence operations by hollowing out the earth for a space far in excess of the apparent requirements of the proposed pond. They then thickly cover the whole of the hollow with a coating of dry straw. The straw in its turn is covered by a layer of well-chosen, finely puddled clay, and the upper surface of the clay is then closely strewn with stones. Care has to be taken that the margin of the straw is effectively protected by clay. The pond will gradually become filled with water, the more rapidly the larger it is, even though no rain may fall. If such a structure is situated on the summit of a down, during the warmth of a summer day the earth will have stored a considerable amount of heat, while the pond, protected from this heat by the non-conductivity of the straw, is at the same time chilled by the process of evaporation from the puddled clay. The consequence is that during the night the moisture of the comparatively warm air is condensed on the surface of the cold clay. As the condensation during the night is in excess of the evaporation during the day, the pond becomes, night by night, gradually filled. Theoretically, we may observe that during the day, the air being comparatively charged with moisture, evaporation is necessarily less than the precipitation during the night. In practice it is found that the pond will constantly yield a supply of the purest water.

"The dew pond will cease to attract the dew if the layer of straw should get wet, as it then becomes of the same temperature as the surrounding earth, and ceases to act as a non-conductor of heat. This practically always occurs if a spring is allowed to flow into the pond, or if the layer of clay (technically called the 'crust') is pierced."



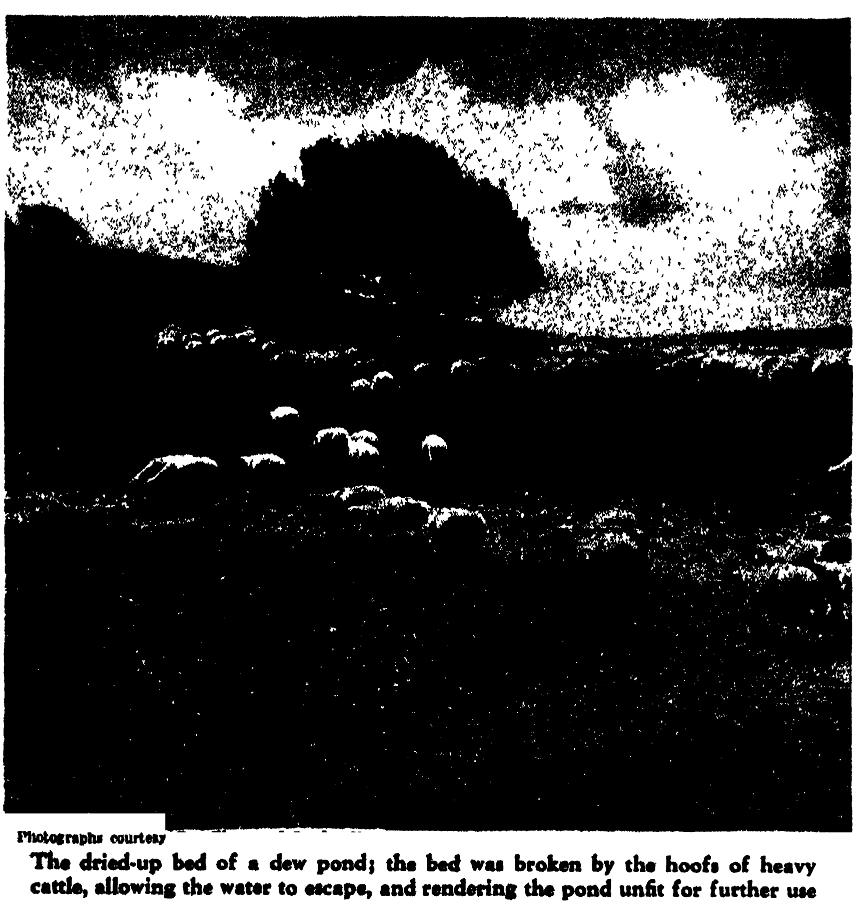
Section of a dew pond, reproduced from "Neolithic Dew-Ponds and Cattleways," mentioned in the accompanying text

In *Scientific American Supplement* Number 1692, June 6, 1908, Edward A. Martin, F.G.S., took quite apparent exception to the conclusions of Messrs. Hubbard, basing the majority of his statements on the theory put forth (and at that time apparently widely accepted) that "dew is really formed from the moisture which rises out of the soil with the radiation of heat, and that it is this which is precipitated when the air into which it passes has been so reduced in temperature as to be unable to hold it as aqueous vapor. If this theory be the correct one," continued Mr. Martin, "it would at once dispose of the suggestion that dew ponds are fed and filled by true dew. . . ."

Reference to the pages of "Physics of the Air," by W. J. Humphreys, C.E., Ph.D., tends, however, to uphold the theory of Messrs. Hubbard in the following statement: "*Dew*, water that has condensed on objects that by any process have attained a temperature below the current dew point of the air immediately in contact with the bedewed objects. The cooling necessary to the formation of dew usually results from loss of heat by radiation."

Whatever the source of the constantly replenished water in the dew ponds of England, certain facts appear to be irrefutable: The ponds do exist, and are constantly refilled, even though no rain falls. If the surface that holds the water is broken, the water drains off and the pond becomes dry.

WHAT the true explanation of dew ponds really is must await an open-minded and scientific series of experiments on a large scale. Whether or not these ponds could be successfully constructed in this country is problematical; we should be glad to hear from anyone who may make the attempt, and to receive data on the exact procedure followed and the results obtained.



Photographs courtesy

The dried-up bed of a dew pond; the bed was broken by the hoofs of heavy cattle, allowing the water to escape, and rendering the pond unfit for further use

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Owing to unforseen circumstances the eleventh article of our series on microscopy could not be included in this issue, but we are promised, for June, one of the best articles of the series—on photomicrography. This article will give definite instructions for [illegible] apparatus—a common electric lamp, your camera, any microscope.—Editor

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.

Lehigh University

Punching Glass Lenses

YOU have heard of shatter-proof and bullet-proof glass, but have you ever seen glass parts being punched out or "blanked" on a mechanical press? This unusual operation is an actual routine job at the Western Electric Hawthorne Works where a battery of bench type presses are blanking tiny lamp cap lenses out of glass rod.

These bits of glass are produced in several colors and are used extensively in telephone switchboards where every hue has a special significance to the telephone operator.

With a glass rod in each hand, an operator punches out small lenses

Glass of ordinary temperatures is, of course, too brittle to stand the rough treatment of a blanking tool, so gas jets have been installed on specially adapted punch presses to heat the end of the glass rod stock until it is plastic enough to be fed into the press. When the softened glass is used up, the rod is returned to the gas jets for further heating. The operators become ambi-dextrous, turning one rod around in the flame of the gas jet while they are punching lamp cap lenses out of another.

The tool that produces these parts is an interesting study in proper timing. The punch is equipped with a device which cuts off the excess material which drops into a waste receptacle under the press. The finished part adheres to the punch on the upward stroke until it clears the die enough to allow room for a horizontal arm to swing under the punch, catch the finished part and tip it down a chute to an asbestos-covered cooling table having a simple circular maze on its surface. The hot part enters this maze at one end and by the time it has been pushed through to the opposite end it is cool enough to be packed for stock.

Metal Surface Is Liquid

AIRLESS electroplating accomplished in vacuum to prevent tarnish of the metal is promised as a result of a report in the British journal *Nature*, by Prof. G. I. Finch, Dr. A. G. Quarrel, and J. S. Roebuck, of the Imperial College of Science, London, that *the surface of polished metal is liquid.*

The liquid surface of metal was found to dissolve any supplied crystals until the saturation point is reached. This suggested to the scientists that metals should be highly polished before they are electroplated.

Testing "Earthquake-Proof" Structures

THE effects of earthquakes on buildings are now being studied at the Massachusetts Institute of Technology by means of a new instrument which measures the stresses in the model of a building frame caused by artificial earthquakes. This instrument, known as a stress recorder, was designed by A. C. Ruge, research associate in seismology in the department of civil engineering, and promises important advances in knowledge of earthquake-resistant methods of construction for buildings, bridges, and other structures. (See also article entitled "Earthquakes" on page 246 of this issue. *Editor.*)

In the solution of construction problems the engineer must translate his fundamental knowledge of earthquake movements into terms of their effect upon the structure he is designing in order to test its strength. For simple buildings he can utilize mathematics, but for structures of more than three or four stories the task becomes so involved as to be practically impossible by such means.

The stress recorder, which weighs only an ounce or so, by an ingenious system of mirrors, lenses, and prisms writes a record of the stresses in models on photographic paper by means of a pencil-point of light moving back and forth across the paper, which is fastened to a revolving drum. Simultaneously, time marks are "flashed" on the record by an electric spark operated by a magnetically controlled tuning fork. This arrangement enables the observer to compute time intervals on the record to an accuracy of 1/1000 of a second or better. The models used in Technology's laboratory of engineering seismology are made up of flat steel bars welded together at the joints. At the "floors" of the frame are iron weights proportioned to represent in miniature the weight of the prototype structure.

A model, if built according to the correct model laws, will react to an artificial

The complete set-up for recording stresses in the study of the effects of earthquakes on buildings. A record is made on the drum in the background

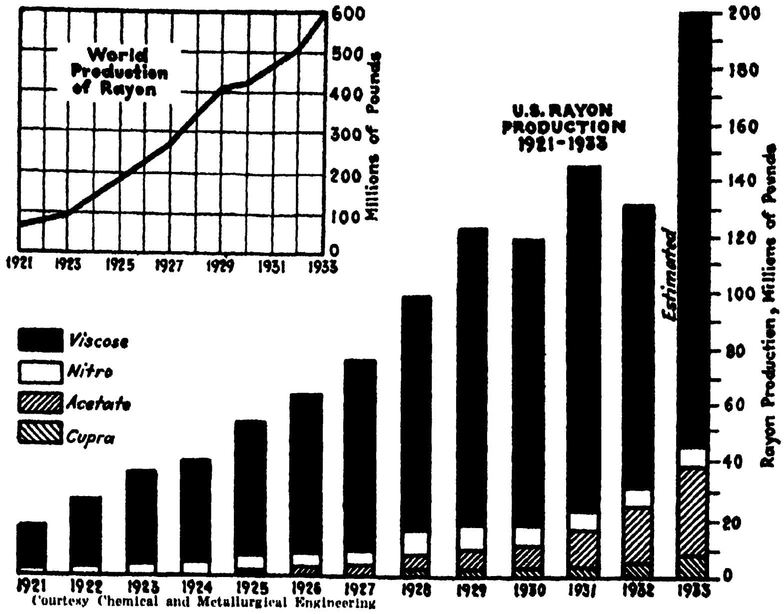
earthquake in exactly the way the large structure would react to a natural earthquake, only on a smaller scale. If the scale is chosen properly it is quite possible to build a model of a ten-story structure having a total height of only four or five feet and a total weight of perhaps a hundred pounds. Such a model can be put on a "shaking table," which produces an artificial earthquake, and the results will immediately reveal more than months of careful figuring could.

Rayon Production in 1933

TWO hundred million pounds of rayon were produced in the United States in 1933—an all-time record, according to *Chemical and Metallurgical Engineering*. World production also rose to unprecedented heights. Somewhere in the neighborhood of 600,000,000 pounds was produced, the United States leading the list, with 2½ times the production of its nearest competitor, Japan; and with Italy, Great Britain, and Germany following closely in that order. In the cases of both the United States and world production, 1932 was badly eclipsed, the former by 52.2 and the latter by 17.8 percent.

Further emphasis is being placed on low-luster yarns and on fine denier filaments. The latter have contributed materially to the truly remarkable improvement in wet and dry strength that has been made in recent years. In the last ten years, according to *Textile World*, dry strength has been increased by 30 to 50 percent and wet strength by 80 to 90 percent.

The anti-creasing process developed by Tootal, Broadhurst and Lee, Ltd., is now being used in at least three plants in the United States. By the formation of a synthetic resin of the urea-formaldehyde or phenol-formaldehyde type within the fiber of the fabric, the resistance to creasing of both cotton and rayon has been greatly increased. Another resin-treated fabric, Revolite, developed by Johnson and Johnson in co-operation with the Bakelite Corporation, was announced within the year. The product resists oil, water, and most cleaning preparations and is used for drapes, theatrical scenery, and similar purposes.—*A. E. B.*



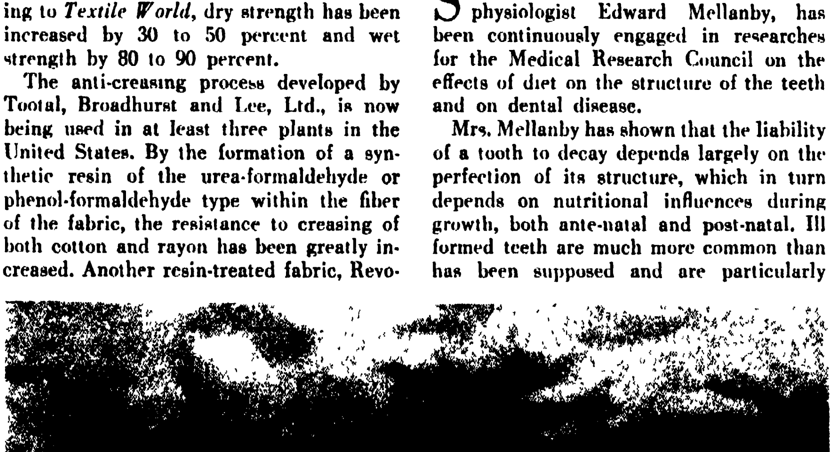
Courtesy Chemical and Metallurgical Engineering

Diet and Teeth

SINCE 1917, May Mellanby, wife of the physiologist Edward Mellanby, has been continuously engaged in researches for the Medical Research Council on the effects of diet on the structure of the teeth and on dental disease.

Mrs. Mellanby has shown that the liability of a tooth to decay depends largely on the perfection of its structure, which in turn depends on nutritional influences during growth, both ante-natal and post-natal. Ill formed teeth are much more common than has been supposed and are particularly liable to bacterial invasion. The teeth require for their formation adequate supplies of calcium and phosphorus and an ample supply of vitamin D to insure that these are put to use. The same factors are necessary for the health of the teeth during the rest of their lives, and especially for the healing of caries (cavities). Thus two main factors control the onset of caries: The better formed the teeth, the more resistant they are; and, independent of structure, resistance is directly influenced by diet.

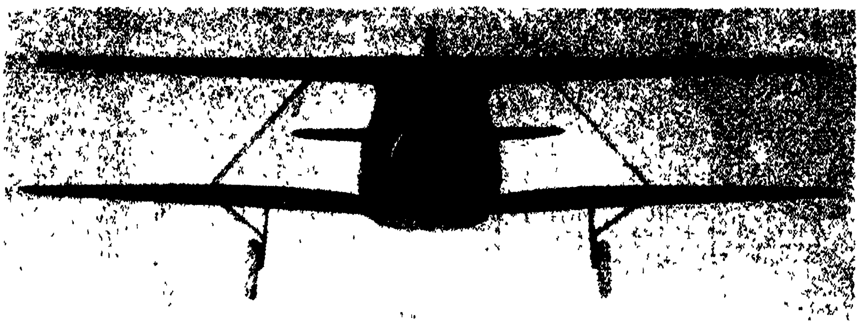
Prolonged studies of children's teeth have confirmed the views formed by Mrs. Mellanby—that the health of the teeth can be largely controlled by certain dietary constituents, some of which are protective and others harmful. Prominent among protective substances is vitamin D (found in egg yolk, animal fat, milk and cod-liver oil). Cereals, such as oatmeal and bread, are given as the best example of harmful foods. Mrs. Mellanby has shown that perfectly calcified and regularly arranged teeth can be produced by including in the maternal diet during pregnancy and lactation, and in the diet of the offspring during dental development, substances containing much fat-soluble vitamin, calcium and phosphorus, such as milk, egg yolk, fish, and animal fats. The vitamin D can be obtained also by exposure of the skin to sunlight or other sources of ultraviolet radiation. Cereals, especially those rich in embryo, such as oatmeal, tend to produce badly developed teeth and call for a corresponding larger supply of calcifying foods for good development.—*Journal of the American Medical Association.*



This artist's drawing shows the design adopted by the Tennessee Valley Authority for the Norris Dam on the Clinch River near Knoxville, Tennessee. The spillway section and the power house are shown. The dam itself is approximately as high as a 20-story building and the power house is as tall as a 12-story building. The dam will create a lake of 83 square miles with a shore line of between 800 and 900 miles. A roadway topping the dam will form the connecting link in the "freeway" which the TVA is building from Knoxville to Coal Creek. Work on the dam is progressing rapidly and probably will be completed within two and a half years. John L. Savage, chief designing engineer of the United States Reclamation Service, directed the design of this, and of Boulder and Madden Dams

Is Washington Monument Disintegrating?

IS that beautiful marble shaft, the Washington Monument, beginning to crumble and decay? Of late years a slow flaking of the marble has become more and more noticeable until Bureau of Standards experts have been called upon to investigate the cause and cure of this "spalling." It occurs mainly in the lower 150 feet of the structure and affects the marble mainly along the horizontal mortar joints. A possible explanation is that the marble is supporting more than its share of the super-



The convertible plane in landing or take-off condition

imposed weight, and that this results in the spalling. With uniform distribution of the load over a horizontal section of the masonry at the ground level and the maximum wind pressure, no part would be stressed as much as 700 pounds per square inch. Tests recently made on blocks of the same material which had been exposed to the weather for about 70 years indicated a bearing power of more than 5000 pounds per square inch. Hence the spalling and cracking of the marble indicate that it is actually stressed much more than the theoretical 700 pounds per square inch.

Details of the early construction of the Monument are not available, but it is believed that a rubble masonry filling exists between the outside marble ashlar and inside walls of granite ashlar. Thin mortar joints in the ashlar masonry and thicker mortar joints in the rubble fill would account for uneven distribution of the loading.

The experiments now in progress are for the purpose of determining if a proposed plan of widening the horizontal marble joints for an inch or more from the surface and refilling with a more elastic mortar will overcome the spalling. For this purpose it was considered desirable to use marble of the same kind as that in the monument and which had been exposed to the weather for a similar period of time. Some blocks were taken from the top of the old Patent Office Building for the experiments, since the marble in it came nearest to satisfying these conditions.—*A. E. B.*

Memorizing Log π

THE logarithm of *pi* to the base ten is often used in scientific problems. To memorize this value to 20 decimal places, memorize the following rhyme. Each word represents a digit of the number, which is determined by the number of letters in the word. "No" represents zero. $\text{Log}_{10}\,\pi = 0.49714987269413385435$.

No task, therefore, becomes a bore
Following pleasant Science.
It simply increases what I use, and
Supplies might, like the lion's.
—*Earl C. Rex, M. S.*

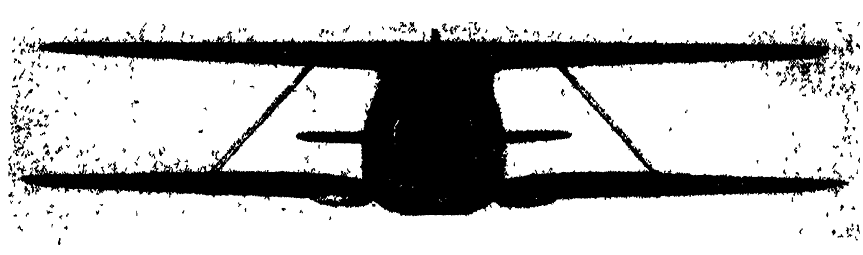
Silver for Oil-less Bearings

SILVER may be used as bearing metal in bearings operating without any lubricants, according to *Chemical and Metallurgical Engineering*, especially for revolving machinery used in high-vacuum equipment. The silver bearings are said to possess very smooth running properties and make it possible to dispense with the undesirable evaporation of lubricants which takes place in high vacuum. Furthermore, silver offers the advantage of such a high melting point, compared with normal bearing alloys, that it is possible to heat the evacuated apparatus to red heat or higher, which is often necessary in the production of a high vacuum.—*A. E. B.*

A Convertible Biplane

THE retractable landing gear has become almost a commonplace. Now we have the possibility of retractable wings. The Aircraft Improvement Corporation has developed a retracting system whereby a biplane can be converted into a monoplane or vice-versa.

One of the photographs shows a model of a biplane with air-cooled engine, a closed cabin body, and a landing gear. If the landing gear is swung about a horizontal axis it can be retracted so that only the wheels project slightly under the lower wing. Then by means of a carefully designed mechanism the supporting struts can be swung backwards and inwards; thus the lower wing on either side retracts and fits snugly into the side of the fuselage.



The landing gear of the convertible plane has been retracted

What is the advantage of such an operation? For landing, take-off, or climb, the lower wing will be extended, the loading in pounds per square foot will be light and hence performance will be good.

For high speed, the lower wing will be retracted, leaving exposed the smallest amount of frontal area.

Exhaustive wind-tunnel tests at New York University have indicated that the idea is thoroughly sound from an aerodynamic point of view. The mechanism has been simply and carefully worked out. Full flight embodiment of the idea is thoroughly justified.—*A. K.*

Flight by Man Power?

WRITING in *Flugsport*, Herr Haeszler advocates the establishment of a prize for a new sport—flight by man power.

He suggests the construction of a large glider of very light weight and clean lines. Within the body of this glider there would be place for a man in a reclining position, with his feet on bicycle pedals. The pedals would drive an airplane propeller through a chain and sprocket. The man-powered machine would be launched into space just like an ordinary glider by rubber shock cord methods. Then the legs of the man would set the propeller in motion and he would be able to stay aloft for a flight of say 1000 yards. The aircraft would be so designed as to be stable, and the only control necessary therefore would be the rudder control, effected through a hand-operated steering handle inside the body of the glider.

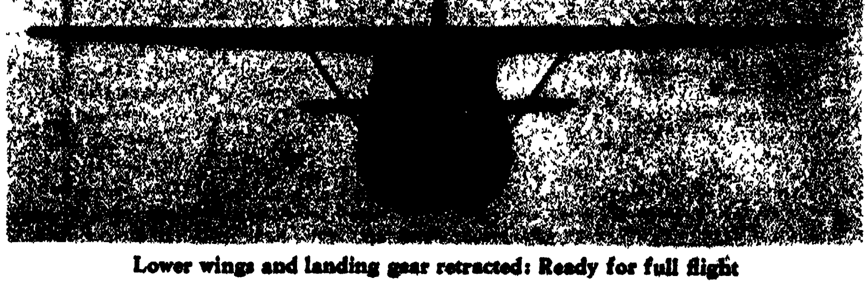
There is no doubt that if such a conception could be realized, there would be plenty of amusement in the new sport—certainly more than in the glider alone.

The question arises: Is the conception at all possible of realization?

To fly at minimum power the weight of the man and the glider must be low, the area of the wings so large that the flight is very slow, and the man himself must be a superlative athlete.

Scientific investigations have shown that a trained runner can achieve 1.4 horsepower for an instant, and average 1.2 horsepower for five minutes. If a glider could be built weighing only 300 pounds (man included) and with a wing area of 400 square feet, then the minimum power delivered to the propeller would have to be 1.04 horsepower. The speed of flight would be 24 feet per second. This would be postulating a very efficient wing, and practically no resistance for the rest of the aircraft.

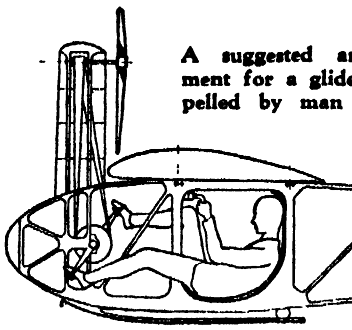
It is difficult to build so light a glider with so large a wing area, and difficult to keep it practically as efficient as the wing



Lower wings and landing gear retracted: Ready for full flight

alone. And it would be a problem to find a very small man with the enormous strength and stamina required.

While the outlook is not promising, it is not hopeless. The practical thing to do would be rebuild a glider, installing the man-power propeller drive, and try it out.



A suggested arrangement for a glider propelled by man power

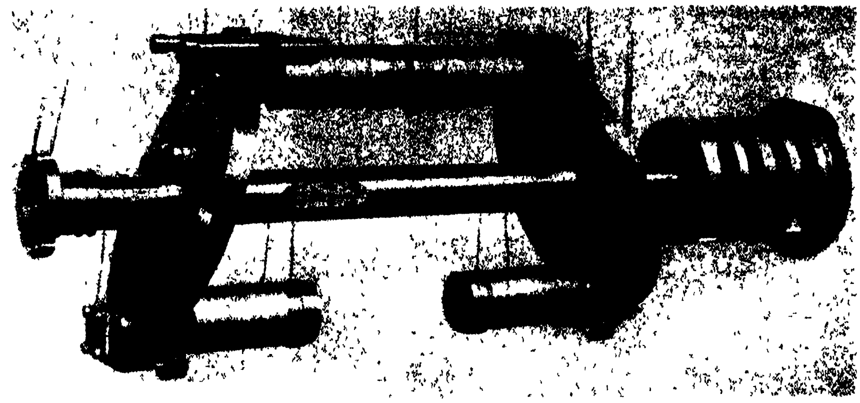
Even if a long hop could not be achieved, the glider once launched would stay aloft longer, and even without completeness of human flight, some exciting sport would be achieved.—*A. K.*

Cows and Aviation

THE cow does not fly, but John Wilson, Chief Inspector of the Boeing Airplane Company, lists many parts of its anatomy which do. The casein in milk makes a strong glue, and casein glue is used extensively in the construction of wing ribs, panels of plywood in the airplane cabin, and so on. Hot glue is made of cow's hoofs. Its hair is used for chair padding and sound deadening. Hides are made into seat covers and straps, and into the fine hide glues which are used in wooden propeller manufacture. Finally, the gold-beaters' skin for dirigibles is made of its entrails. Certainly the cow makes praiseworthy contributions to aerial navigation.—*A. K.*

Pre-Stressing Concrete

A NOVEL type of concrete construction was exemplified in the pre-stressed concrete tank recently exhibited by the Stebbins Engineering Company. This tank was built by pouring concrete within forms in which asphalt-coated stressing rods are suspended. After the concrete has set, compression is applied to the wall by tightening nuts on the ends of these rods. The next operation is to tighten continuous hoops around the tank to the desired stress. The tank is then finished by applying a coat of unstressed concrete outside the hoops. Bottoms are made with radial reinforcing and linings and generally of acid-proof stoneware. Dome covers are built on a beam principle and attached to the body by the stressing rods.



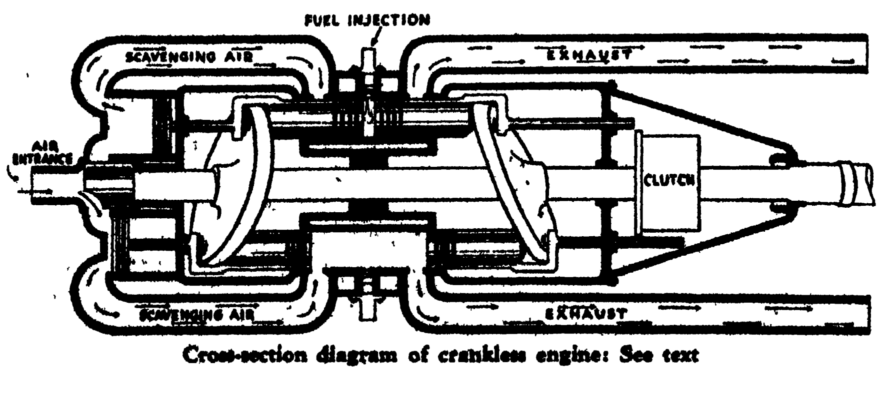
The pistons and oscillating disks of the crankless engine described

Tanks of this have been used for boiling tanks in the pulp and paper industry. At lower temperatures they are suitable for pressures as high as five pounds per square inch in a 30-foot diameter tank. Water tanks as large as 120 feet in diameter have been built.—*A. E. B.*

A Crankless Engine

THE Sterling Engine Company has produced a novel engine, which while primarily designed for motor-boat work has real possibilities in the aircraft field. It is a crankless, two cycle, compression-ignition engine burning heavy fuel oil. Camshafts, cylinder heads, valves, and other parts are eliminated.

In our diagram and photograph two combustion chambers are indicated. Two opposed reciprocating pistons work in each combustion chamber. The cycle of operations is as follows: The bottom cylinder has its pistons at its maximum displacement from one another. The ports at either end of the chamber are uncovered. Through the left-hand port scavenging air under pressure is being admitted; through the right-hand port the exhaust gases are being evacuated. Next the pistons approach one another, shutting off the ports until a very narrow space is left between them. This is the condition for the upper chamber of the diagram. The air at this instant is raised to an enormous pressure, and simultaneously fuel is injected. Owing to the pressure and high temperatures developed, the fuel and air mixture ignites spontaneously without the aid of electrical ignition. The pistons then move apart on the power stroke which ends with the ports again being uncovered for exhaust and scavenging. To make the scavenging air most effective it is compressed in the two cylinders at the extreme left, in which pistons move in unison with the main pistons.



Cross-section diagram of crankless engine: See text

Now we come to the elimination of the crank, from which elimination the name of the motor derives. This is accomplished by the two inclined disks, which are virtually flywheels, driven at either end through Mitchell or Kingsbury thrust bearings (such as are universally used on ships the world over). As the inclined disks oscillate and rotate, they turn the central shaft.

Why are we so sure that such an engine has decided possibilities for aircraft?

Because, first of all, this arrangement allows the prime mover to have minimum frontal area for a given power. A powerful water-cooled unit could disappear completely within an airplane wing. Another advantage from an aircraft point of view is the burning of non-inflammable fuel.

There is one other point to which attention must be drawn. In the ordinary two-cycle engine in which fuel and air are admitted together while exhaust is still going on, there is always some loss of the incoming charge. With fuel injection at the instant of maximum compression such loss disappears, since fuel is only admitted when both the air inlet and the exhaust ports are closed.—*A. K.*

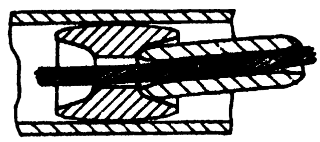
Pushing 'Round a Corner

ONE of the problems of airplane construction is control at a distance. It is easy enough to exercise a pull at a distance, but it is not so easy to push at a distance, particularly if the push has to be "'round the corner"; that is to say, not in the same straight line as the original push. For example: The pilot may have to open a throttle for an engine which is mounted outboard on a wing. Here the effort has to be carried back in the fuselage, outward along the wing and then perhaps upward and forward to the engine nacelle. The throttle may have to be opened or closed. Therefore if a pure cable system is employed, it has to be in duplicate; one cable pulls the throttle one way, the other cable reverses the action. Moreover, cables are not always positive enough. Therefore, where distance controls 'round corners have to be employed, designers may employ push rods, and a number of bell cranks. Push rods and bell cranks are apt to be heavy and awkward.

These problems arise with auxiliary balancing surfaces on the rudder, elevator, or aileron; throttle and spark controls; carbureter adjustment; controllable pitch propellers, and so on.

The Simmonds-Brewster control system

Left: **Near the lower left-hand corner is a group of parts for the new airplane control cable designed for pushing around corners. Sections of the cable and housing are shown to the right in the photograph.** ***Below:*** **A cross-section drawing of one of the "olives" of the cable system**



seems to accomplish this pushing "'round the corner" in a simple and ingenious manner.

In this control, there is first of all an inner cable. This gives a pull at a distance, no matter whether action is in a straight line or not. The cable passes loosely through an "olive," as shown in the drawing. The "olive" has a socket-like recess at either end. Into these sockets fit "spacers" which are tubes with rounded ends. The spacer can evidently move around in the socket of the olive. Now let us imagine the cable, the olives, and spacers mounted in an outer casing. Quite evidently a pull at one end will be transformed into a pull at the other end through the cable. A push at one end will tighten up olives and spacers and so compression can be transmitted through the tube but owing to the ball and socket arrangement, flexibility is not lost. The ends of the cable can be adjustable, provided with eye-ends, lock nuts, and so on.—*A. K.*

A Dangerous Sport

IT is considered exciting sport to hunt birds or foxes. Sportsmen travel to Africa to kill lions and be thrilled. But here is a more exciting sport in reverse: to be hunted by bombing airplanes while seated in a motor boat. Of course, the bombing pilots do not attempt to hit the target; their aim is to come as close to it as possible without actually scoring a direct hit. But even then sitting in the target boat must be far from soothing to the nerves. This form of target practice is considered highly effective training by the British Royal Air Force. The boats are 37 feet 6 inches long, are constructed of mahogany, powered by three 100 horsepower engines, and develop a speed of more than 30 miles per hour. They also have great maneuverability and can lay effective smoke screens as added protection against the bombers.

In the construction of the boat every precaution has been taken against accidents. Thus the crew, sitting amidships, is protected by an armored cowling. This cowling is continued over the machinery and gasoline tanks. The sides of the vessel are also protected in like manner. Forward of the steering compartment is a small cockpit with duplicate controls, so that when the boat is not in use as an actual target the crew can drive the boat from the forward position.

There are still other precautions: Forward of the open cockpit, the hull is filled with a form of expanded rubber which weighs about 1/10th as much as cork. This material is extremely buoyant and should bombs be dropped on this section of the hull (even if they passed right through) the rubber filling would prevent the boat from sinking. The hull is also divided into water-tight compartments so that if a bomb passes through one section of the hull only that one section becomes water-logged and it is possible for a member of the crew to proceed forward, plug the hole when not being bombed, pump the water out quickly, and proceed with the regular day's work.

The boat is of course quite inexpensive compared to the armored battle cruisers previously used in such target practice.

Having read of these various precautions, are our readers anxious to act as targets for a few fast bombing planes?—*A. K.*

Fake or Fact?

CAN a South Sea Islander walk barefooted over red hot stones? A reader of this magazine, Mr. A. W. Peters, of Kirkwood, Missouri, submits this question in the following form:

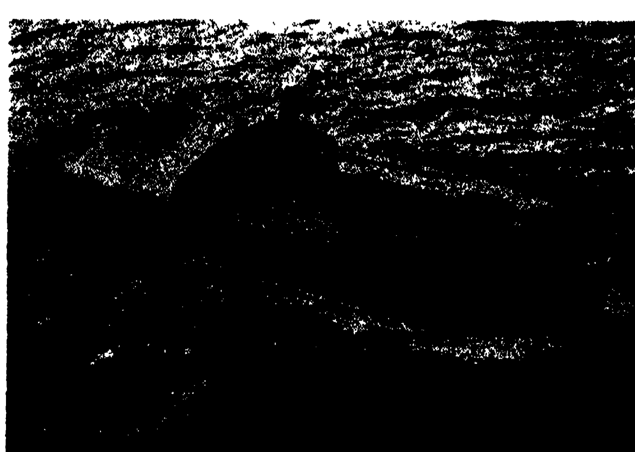
"In Frederick O'Brien's book 'Mystic Isles of the South Seas' he describes a ritual performed by certain tribes in Tahiti which consists of walking barefooted over red hot stones heated in an excavation 25 feet long by 15 feet wide by five feet deep. Mr. O'Brien states there was no trickery used, nothing put on the soles of the feet, and that while a paper he threw on the stones was immediately consumed, the persons who walked over these same stones were apparently not injured although the leader stood in one spot while being photographed.

"Was Mr. O'Brien in a sort of hypnotic state, or is such a procedure a fact?"

Mr. Peters' question was referred to the anthropologist, Dr. Alfred L. Kroeber, who passed it to Mr. Peter H. Buck of the Department of Social Sciences at Yale University. Mr. Buck replied to it as follows:

"I saw a party of Fijians perform the ceremony some years ago in New Zealand. It looked very simple and natural. In the Society Island Group it used to enter into certain religious rituals in the island of Raiatea, which was the religious center of the Group. I met an old Raiatean who had taken part in such exhibitions and he said it was a good 'stunt.' The religious side of the business had disappeared and he looked upon it merely as a spectacular exhibition.

"The question why people can walk over hot stones is a job for the physicists who are concerned with heat. I do not know of any scientific investigation having been made by men who are qualified. The general opinion appears to be that the stones used are bad or rather poor conductors of heat. The heat of the upper surface of the stones is not sufficient to burn the thick soles of the fire-walkers unless the feet re-



Courtesy The British Power Boat Company

Placing the armored cowling over the pilot's position in the speed-boat used in aerial bombing practice maneuvers

One of the speed-boats, described above in the item "A Dangerous Sport," being driven from the open cockpit

main in contact with the same stone for some time. The natives walk deliberately over the stones, but they don't stand on the same stones for any length of time.

"In preparing the oven, the natives were careful to level out the hot stones so that they would not slip, and to remove burning pieces of wood and hot embers from the surface of the stones. They were careful not to tread on live embers that stuck in the interstices between the stones. Thus live embers burned, but the upper surface of the stones did not affect them.

"I regret that I cannot give you exact details to meet your requirements but as I said before it is job for a physicist and not a humble ethnologist."

Steel Roads

STEEL as a road-building material is being widely experimented with abroad, according to the *Industrial Bulletin* of Arthur D. Little, Inc. "For new road construction, iron grilles, weighing about 50 pounds per square yard, are anchored to the gravel bed, welded or bolted together, and then covered with about two inches of asphalt and fine gravel. The grilles are made at the factory, making the labor of using them very slight, on the job. The idea of metal roads has been tried to a certain extent in this country, and American companies are watching these new European tests with interest, for 500 to 1000 tons of steel per mile of road is no small matter."—*A. E. B.*

A Magnificent Airport

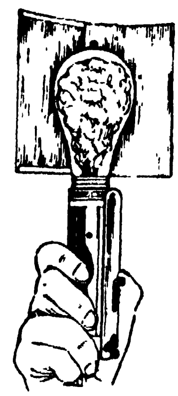
EARLY in March Pan American Airways opened a magnificent airport on Biscayne Bay, Miami, Florida. The airport area covers about 44 acres of land. At its central point is located the passenger terminal, in the form of a three-story building. This houses waiting rooms, international mail office, emigration offices, customs rooms, and so on. The spacious central hall is two stories high, and its ceiling is decorated with the signs of the Zodiac, historic airplanes, and so on. A huge globe is placed in one wall, and moving pictures may be shown on the other side. Around the hall are baggage rooms and offices for the airway personnel and radio and weather services.

The lower floor of the building gives access to covered steel gangways which lead to the docking floats. There will be no confusion for outgoing or incoming passengers, since there will be but one way for them to go when embarking or disembarking and visiting the various offices for necessary formalities.

Extensive parking facilities, docking facilities for planes of over 200 feet in span, and a fine architectural and landscape layout complete the airport.—*A. K.*

Camera Shutter Synchronized With Illumination

THE amateur photographer who makes use of Photoflash bulbs for photographic illumination will find a valuable accessory to his work in a little device called the Photoflash synchronizer. This consists of



The handy device for synchronizing the camera shutter with the light from a Photoflash bulb. The cable release of the camera is placed in the slot near hand

an ingeniously designed folding reflector, a holder for flashlight cells, and a combination switch and cable release mechanism. In use, the cable release of the camera is clipped into position on the synchronizer, the Photoflash bulb is inserted in the socket, the camera is focused, and the trigger on the side of the Photoflash bulb holder is released. This trigger, at one and the same time, closes the circuit of the Photoflash bulb and presses the cable release. Thus the instantaneous illumination and the operation of the camera are perfectly synchronized.

New Yellow Fever Serum

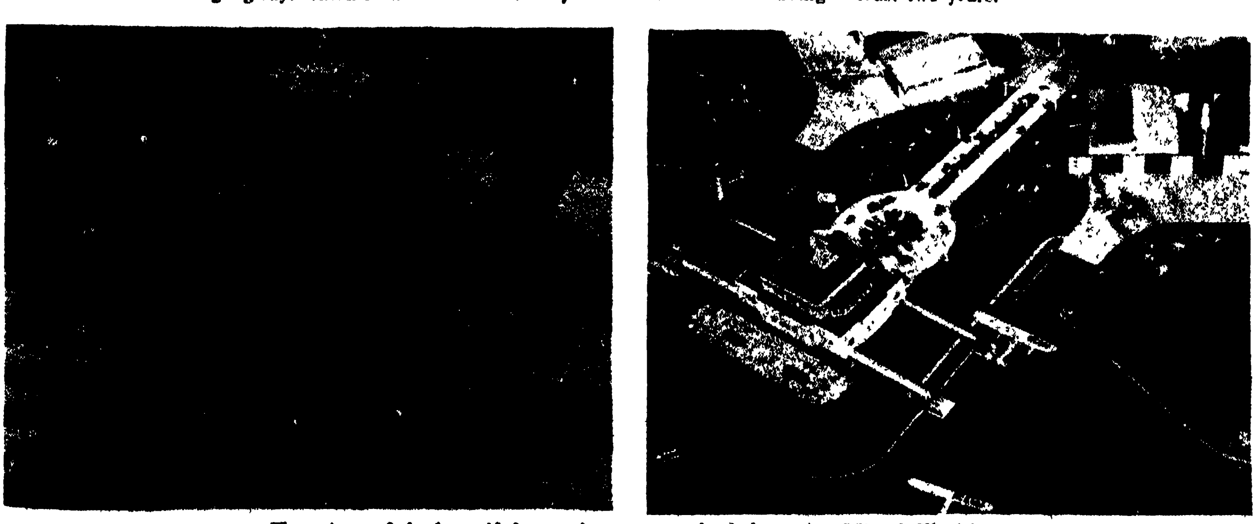
MISSIONARIES, government officials, and scientists whose work takes them into regions where mosquitoes carrying yellow fever may bite them are now being

In a "Vitamin Plant." Here, in a modern factory, under ideal conditions, the vitamin of cod-liver oil is extracted and concentrated. See also the article on the same subject on page 244 of this number

adequately protected against this toll-taking disease.

For two years medical research scientists of the Rockefeller Foundation, working in New York at the Rockefeller Institute for Medical Research under the leadership of Dr. W. A. Sawyer, have applied practically their vaccination technique. Yellow fever virus made safer by at least a hundred passages through white mice is used. Along with the weakened virus human blood from those who have had the disease or have been vaccinated is injected without bad effects. There results an active immunity similar to that which is caused by an actual attack of the disease.

When in 1931 vaccination against yellow fever was announced to the medical world at a meeting in Philadelphia, it was not known how long the immunity caused by inoculations with immune blood serum would last. Experience has shown it to be exceedingly efficient. Protection lasts at least two years.



Two views of the beautiful new airport recently dedicated at Miami, Florida

Now efforts are being centered upon making the injections less difficult and less costly in human blood. It is not yet practical to protect a whole population against yellow fever, but those most in danger can with safety do their work in dangerous areas.

The Pasteur Institute in Paris has used in its yellow fever vaccinations the blood of immunized horses.—*Science Service.*

Draw Bridge for Industrial Plants

IN industrial plants, where it is desirable to cross over depressions or to bridge railroad tracks and other rough going, a small easily operated draw bridge can be

used to solve the problem. This draw bridge, shown in the illustrations, can be supplied with either hand or power operation; in the latter case the control can be placed at some distance from the draw. The counter-balancing method permits extremely easy and fast operation. The entire bridge and its supporting structure is strongly braced to carry any ordinary loads.

Big Telescope Mirror Cooling

A HUGE pancake of Pyrex glass, more than a foot in thickness, nearly seven feet in diameter and weighing 5600 pounds, is being cooled slowly at the rate of two to four degrees a day. This cooling process will continue for more than three months. At the end of that time the glass pancake will be the raw material for the 80-inch mirror in the reflecting telescope being built by the Warner and Swasey Company, Cleveland, for the McDonald Observatory of the University of Texas.

The mirror was poured by the Corning Glass Works, Corning, New York, in the presence of company officials, Dr. Otto Struve, director of Yerkes Observatory and the new McDonald Observatory, and E. P. Burrell, director of engineering for the Warner and Swasey Company.

The grinding of such an enormous mirror, exceeded only in the entire world by the 100-inch reflector at Mt. Wilson, is a long and tedious process. With good luck, it may take only a year. If all conditions are not perfect, it will take as much as two years.

When the mirror is completed, it will

Above and left: **The draw bridge for industrial plants, showing operation, and how it bridges depressed roads, canals, or railway tracks**

measure 80 inches in diameter, 12 inches in thickness and will have a concave upper surface one and a quarter inches deep. Through the center will be a hole 13½ inches in diameter for the passage of light rays.

Engineers Play Ping Pong to Test Lighting

FROM a delightful indoor sport, Ping Pong recently was elevated or degraded —purely a matter of viewpoint, of course— to a practical engineering demonstration of the latest kind of electrical illumination. O. H. Biggs and W. P. Lowell, Jr., both of the lamp engineering department of the Hygrade Sylvania Corporation, arranged for several Ping-Pong matches under a huge canopy containing the usual tungsten filament lamps and the latest sodium vapor lamps, either set being switched on at will.

These enterprising engineers wanted to determine whether the flicker of sodium vapor lamps—and there are 120 flickers per second with the ordinary alternating current circuit—would have an appreciable effect on the action. And they further tried to determine whether the absence of all colors, except yellow, would make any difference to the players, for under these lamps everything appears yellow, gray or black.

The Ping-Pong games did indicate some stroboscopic effect; that is, the ball and paddles did intermittently flash before the eyes. To some it seemed more noticeable than to others, and opinion was very much divided as to whether it is an asset, drawback, or immaterial.

But the color of the light, at least to those who tried playing the game, made no apparent difference. For while, as one expressed it, "you see better but not so much" under the deep yellow, almost amber light of sodium vapor, the contrast was not marked enough to reveal any departure from normal in the eye activity or see-ability of the players.

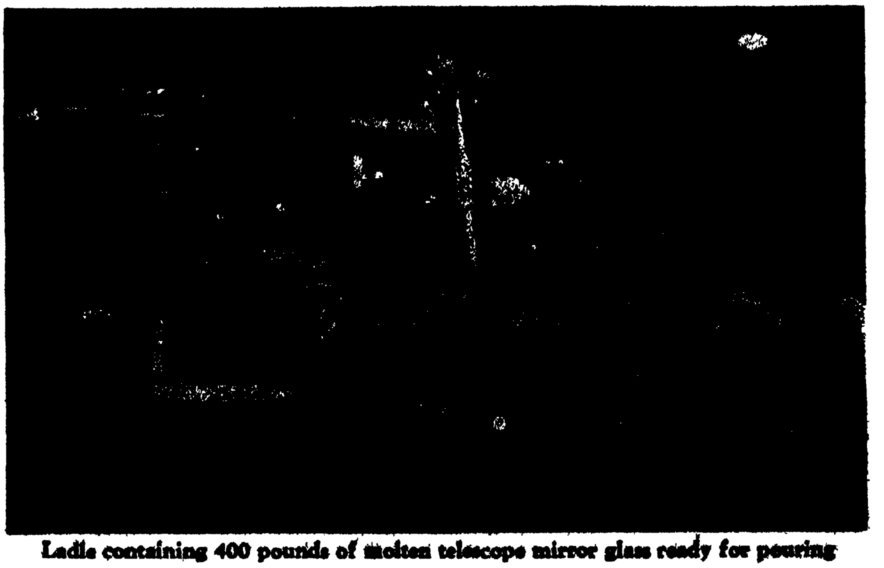
The present interest in the sodium vapor lamp is due to the enormous gain in luminosity with a given current consumption or wattage rating. The new lamp produces two and a half times as much light as the usual tungsten filament lamp of corresponding wattage. This enormous saving in current consumption is attracting the attention of illuminating engineers particularly with highway lighting in mind.

Protective Coating for Stone

A PROTECTIVE coating for stone surfaces, particularly adapted for use where stone walls are subjected to the corroding effects of chemicals or to mechanical abrasion, have been developed from certain silicic acid esters. Tetraethyl silicate ester, dissolved in alcohol, to which has been added the desired pigment, may serve for this purpose. As the coating is applied, the silicic acid is set free, and a rapidly drying insoluble film results which is easy to clean and which possesses great resistance to chemical attack and to mechanical wear. By use of proper pigments it may be made to resist temperatures up to 1200 degrees, Centigrade.—*A. E. B.*

Sex Predetermination Hopes Raised

HOPE that it will be possible for parents to determine in advance the sex of their children was renewed recently by a report of medical research that appeared in



Ladle containing 400 pounds of molten telescope mirror glass ready for pouring

the British journal, *Lancet.* Drs. Harold Taylor and Gordon Kirwan-Taylor, London gynecologists, tell how they successfully applied a modification of a German method of predetermining sex of human beings.

It is a matter of the acidity of the fluids involved and the time relations of the monthly physiological cycle.

Three cases in which births have occurred resulted as the doctors planned and the parents desired. Other cases are pending.

There is a diversity of opinion in scientific circles about the validity of the methods used. Critics of the findings emphasize that the evidence must be much more voluminous before any conclusions can be drawn with general assurance.

The sex predetermination technique depends on the chemical reactions of the vaginal secretions. It was found that the secretion is usually nearly neutral immediately after menstruation, becoming progressively acid until the next period. This is modified by the alkaline cervical flow during coition. Without coition monthly variations in the individual's acidity are normally uniform. Thus a series of examinations during one cycle can guide the physician's advice as to the time of coition and the treatment that should be undertaken during subsequent cycles. The treatment consists of douches, which if too alkaline, too acid, and too shortly before

coition tend to produce sterility. The observations of the London physicians confirm the conclusion that uninterfered coition following menstruation tends to produce sons and before menstruation tends to produce daughters.—*Science Service.*

American Grown Rubber in Auto Tires

RUBBER from the only large source within the borders of the United States, the guayule shrub, has been given a commercial test in automobile tires and tubes. What the motorist and the army could expect from tires that would have to be made from this local source in case of a war embargo was told to a gathering of chemists of the American Chemical Society recently by J. Harvey Doering of the Firestone Tire and Rubber Company.

The test tires built by this company from rubber that was exclusively guayule failed between 8500 and 10,200 miles because of tread wear. The inner tubes proved satisfactory throughout the test.

The chief difficulty with the extensive use of guayule rubber is its high resin content, Mr. Doering said. This can be overcome by an expensive process that will remove the resin. The tires tested were not made from treated rubber, but contained from 18 to 20 percent of resins. These rubbers are extremely soft and sticky so that it was found necessary to add several "drying" pigments before the tires could be built.

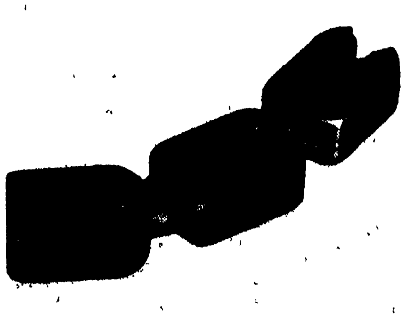
Small quantities of dirt and bark in the rubber made it very difficult to build good tubes. Mr. Doering expressed the opinion that these foreign substances could be removed by some straining method such as is used in cleaning reclaimed rubber.

It seems very improbable that the guayule product will take the place of hevea rubber imported from the East Indies except as an emergency measure, such as war. Uncle Sam probably has enough stored away, in the form of new and reclaimed rubber, to last the nation for perhaps two years in case of war, while rubber experts are developing this emergency supply. Under these conditions Mr. Doering promised guayule tires as good as the fabric tires of 1918.—*Science Service.*

A Ball and Socket Power Conveyor

WHEREVER boxes, cans, cartons, bottles, and other uniform packages are to be carried regularly between certain equipment or locations in a factory or other industrial plant, a new power conveyor can often find an economical and desirable application. This type of conveyor, shown in the photographs in these columns, is small and compact, may be reversed when required, is easy to maintain, and above all, is strong and sturdy in construction. The links of the chain are of such length that it can follow very short curves in the conveyor line. The ball and socket connection between each link of the chain is so simply constructed that it can be separated or put together by hand. The wear and tear on the chain itself is distributed over large surfaces in the ball and socket, and efficient lubrication is maintained automatically.

These chains can be used either singly or in multiple installations, and are adaptable to shunting materials from the main conveyor line to a siding.



***Right:* The ball and socket power conveyor in operation, showing the sharp turns that can be made. *Above:* Three of the links, indicating the angle at which the chain may be bent. *Upper left:* The links may be connected or separated by hand without the use of tools**

Arabic Numerals Not Arabic

CREDIT where credit is due, even at the cost of racial prestige, is accorded by the Arabs in their mathematics books, says Dr. George Sarton, historian of science and research associate of the Carnegie Institution of Washington.

It has been known for a long time, Dr. Sarton notes, that the system of numerals commonly called Arabian really originated in India. However, he adds, they have never been called Arabian by the Arabs themselves. In their books they always call them "Hindu numerals."—*Science Service.*

Desert Marsh Yields Chemical

SODIUM sulfate, once a plentiful by-product of nitric and hydrochloric acid manufacture, has become relatively scarce in this country because of recent changes in the manufacturing processes of those acids. Just when it began to appear that the United States would have to depend on imports for its sodium sulfate, an isolated desert marsh began to yield this chemical, in practically pure form. This strange deposit, where sodium sulfate, or "glaubers salt" can be scooped up by steam shovel is known as Rhodes Marsh, and is located in Mineral County, Nevada. P. C. Rich relates the story of this unique development in *Chemical and Metallurgical Engineering.*

A few years ago, P. S. Williams, a chemical engineer at one time associated with a concern producing sodium sulfate from Carrizo Lake, California, came across an old report of Prof. Joseph LeConte, geology professor at the University of California, in which mention was made of an enormous deposit of glaubers salt at Rhodes. In 1928 he was able to interest a group of San Francisco men who spent considerable time prospecting the deposit, surveying the markets, and investigating processes for recovery of the sulfate. The first plant was erected in 1930. With the experience thus gained as a basis, a program of improvement was initiated late in 1932, under the

superintendence of D. E. Root. At the present writing the out-put is about 50 tons of finished salt cake per day.

Rhodes Marsh is roughly circular in shape. The mineralized section is about 200 acres in area and covered with six inches to 2 feet of silt. On the south half of the deposit, a 15-foot layer of glaubers salt is found immediately under the overburden; in places it has been found to be present at a depth of 80 feet. The north half of the deposit is slightly different in character, large areas having been marked in which the glaubers salt is overlain with thenardite (anhydrous sodium sulfate) in a layer from three to five feet thick. In this portion the overburden consists of salt (NaCl) as well as fine silt.—*A. E. B.*

Cod-Liver Candy Bars from Canada

IF Junior refuses to take his cod-liver oil "straight," he probably will not object to eating it in a candy bar or ice cream, which he may soon be able to do as a result of recent investigations.

A method whereby the fresh cod livers can be mixed with cocoa in such a way that all the health-giving properties of the livers are retained without oiliness or objectionable taste or odor remaining, has been devised by H. A. Wentworth of Fairhaven, New Brunswick, the Canadian Department of Fisheries has announced. The new mixture can be successfully used in the manufacture of a chocolate-coated confection.

Manufacture of the candy has already been started and persons who have eaten it declare it is impossible to notice any taste of the oil. The liver-cocoa mixture has also been used in making ice cream and milk and egg shakes.

While the mixture carries no taste or smell of oil, it is produced by a "cold process" and it is stated that there is no impairment of the livers by chemical or physical changes and that they therefore retain unchanged in quality their natural maximum quantity of vitamin A, the growth vitamin, and vitamin D, the rickets-preventive, "as well as substances for pernicious anemia and goiter therapy."

It is not only the livers of codfish which can be treated by this method. Other species of fish which store up their oil in the liver instead of having it distributed through the body would be a source of supply, such as the halibut, and an important effect of the work may be the enlargement of the demand for this type of fish.—*Science Service.*

Many New Dairy Methods Perfected

THE Grove City Creamery at Grove City, Pennsylvania, together with the surrounding farming community, has become widely known as a "proving ground" for new ideas in dairying as a result of co-operative activities with the Federal Bureau of Dairy Industry.

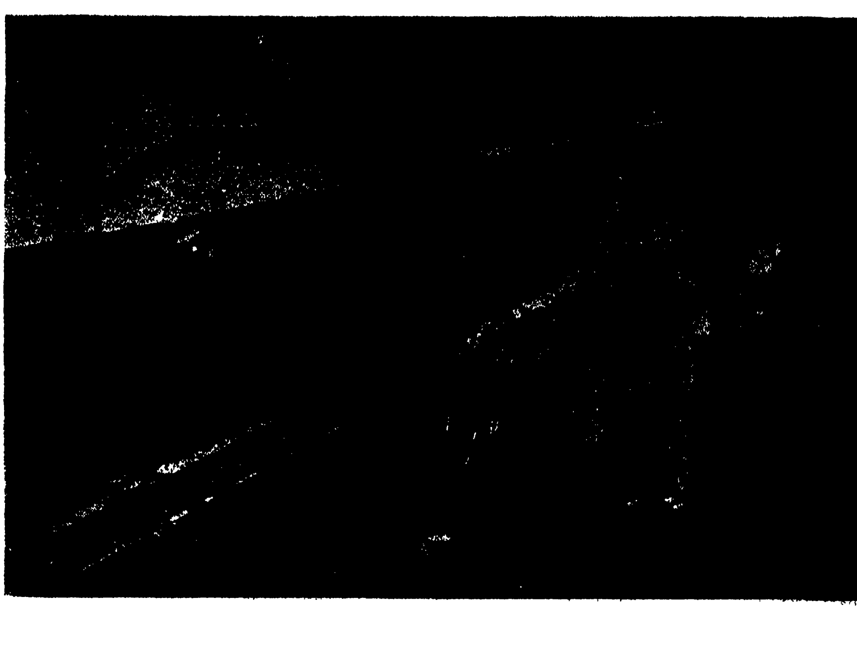
Swiss cheese is now widely made by the "culture" method perfected at Grove City, and more and more factories are making cheese equal in quality to the imported kind.

Roquefort cheese can now be made from cow's milk in this country, instead of from sheep's milk as it is in France. Recent developments indicate that sealing this cheese in cans and storing it at low temperatures preserves the color and general condition and makes a convenient package for shipping.

The new method of making a low-acid rennet-type cottage cheese has served to increase the popularity of this product, and its manufacture provides a desirable outlet for surplus skim milk in many Pennsylvania factories and elsewhere.

An improved method of making concentrated sour skim milk for animal feed was perfected a number of years ago, making it possible to convert skim milk into a form in which it can be preserved and transported for feeding to hogs and poultry in sections where milk products are scarce. Last year 25 factories converted 34 million pounds of skim milk into the concentrated product.

New methods for producing various dairy products are mentioned in the item above. While these processes have been developed, mechanization of the dairy has kept pace. In an American dairy farm (shown below), high-speed automatic milking machines deliver the milk to sterile glass containers. In England, also, mechanical milkers are gaining popularity. At the *left* is shown a group of milkers at a Keswick (England) farm with up-to-date milking equipment



Sticky Statistics

IT has been said that animal glue serves man from the day he is born and placed in a cradle until he is laid to rest in a casket. The extent of the animal glue business in this country can be appreciated from the fact that the domestic production of glue from hide and bones totaled nearly 60,000,000 pounds in 1931.

George I. Cooper, writing in *Chemical Industries*, discloses the somewhat surprising fact that the strength of animal glue is nearly always underestimated. Whenever it is used properly, it provides a factor of safety which is so large as to be a virtual guarantee that if failure occurs it will not take place in the glue itself. The tensile strength of the best grades of woodworking glue is 20,000 pounds to the square inch.

Wood joints, made under proper conditions with ordinary paper box glues show, when ruptured, wood failure while the glue has held perfectly. This proves that the tensile strength of the lowest grades of animal glue is greater than wood, although their use is not recommended for woodworking because to give such results they must be used under more exacting conditions than prevail in commercial shops. —*A. E. B.*

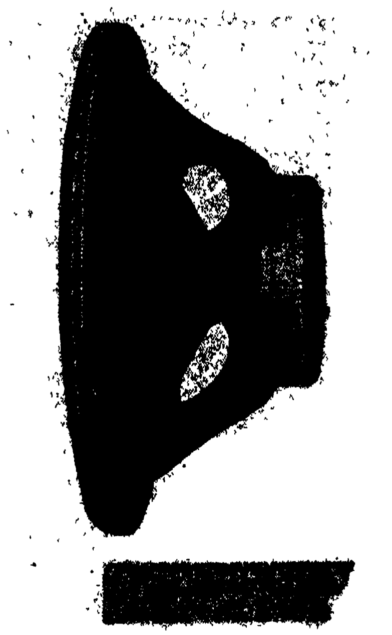
Crystal Speaker—Crystal Tones

THE advent of a new crystal speaker with a sensitivity said to be much greater than that of the magnetic speaker and somewhat greater than that of the ordinary dynamic is causing an increase in the use of centralized radio in schools, hospitals, and hotels.

After many years of experimenting, it was found that crystalline plates of Rochelle salt cut perpendicular to the "A" axis and with the edges at 45 degrees to the "C"

axis tend to expand and contract longitudinally in response to applied electric potentials. Consequently, a bimorph element consisting of two such plates cemented together and provided with proper electrodes will, when held at one end and charged with an electrical potential, bend and move in a direction perpendicular to its major surfaces and parallel to the "A" axis.

Through such discoveries, a double curvature bimorph element was developed as



The new crystal loudspeaker. Note comparison with a ruler (below)

the standard speaker driver, which was two and a half inches square by one quarter inch thick. This element is clamped between rubber at three corners. The fourth corner engages a $2\frac{1}{2}$ to 1 step-up lever arm, the free end of which drives a small cone. When so arranged and operated from a conventional radio amplifier, the speaker gives a very good response throughout the broadcasting range.

Some of the advantages of this new speaker are clear tone, compactness, permanence, and low cost; it requires less power for operation, and only a two wire lead is necessary as there is no field current to be supplied.

New American Made Telescopes

ENCOURAGED by the tremendous success of their 6-power achromatic telescope the Wollensak Optical Company, Rochester, New York, has introduced a complete line of American-made achromatic telescopes. Because of their optical systems and construction these new telescopes are considered the finest in the world in their price classes. They are excellent for all-around sports use and especially suited for use as spotting 'scopes by marksmen.

You Get Sweeter When You Smoke

THE gratification you get from smoking, particularly when you are tired and hungry, is due to an increased amount of sugar in your blood brought about by the

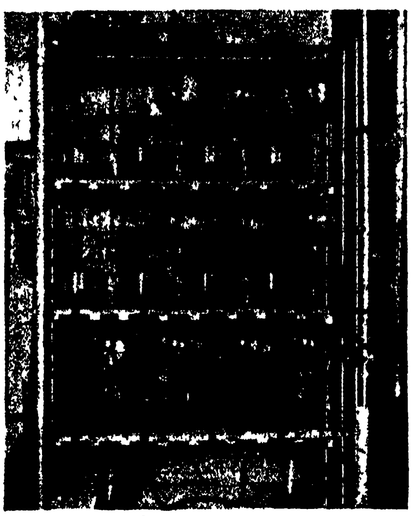
nicotine from your cigarette—or pipe or cigar. This explanation of what has long been a mystery has just been reported by two Yale University scientists, Drs. Howard W. Haggard and Leon A. Greenberg, to the scientific journal, *Science*.

The nicotine in the tobacco acts upon the adrenal glands, causing them to discharge more adrenalin into the system. As a result, the glycogen stored in liver and muscles is converted to sugar, and the sugar concentration of the blood is increased.

The same thing happens after a meal. It is this increased sugar concentration that definitely relieves the fatigue and irritability which develop when the amount of sugar in the blood is at the fasting level; in other words, when you are hungry. This also explains why many tobacco users smoke when they feel tired or hungry. The nicotine relieves the hunger and fatigue temporarily by increasing the amount of sugar in the blood.—*Science Service.*

Improving Honey

TRAIN your bees to sip their honey only from orange blossoms and sweet clover if you would have them produce the clearest grade of honey. This, at least, is one



Battery of ultra-filtration units used to remove turbidity of honey

of the conclusions that the layman would draw from the elaborate and interesting experiments of H. S. Paine, S. I. Gertler, and R. E. Lothrop of the Bureau of Chemistry and Soils, who report their exhaustive investigations of honey in *Industrial and Engineering Chemistry*.

It has been known that the color, the turbidity, and the caramelization temperature of honey are influenced by its colloid content. Some of the difficulties encountered in the commercial handling, processing, and packing of honey are traceable, in part at least, to the presence of relatively small quantities of colloidal substances. Extracted honey for the retail trade comes into competition with sirups, and, especially when packed in glass containers, suffers by comparison with the clarity and brilliance of appearance to which the public has become accustomed. So the investigators determined to find out whether the amount of colloidal matter in the honey could be controlled by regulating the "diet" of the bees. They collected 37 samples representing the most common American floral types and filtered out the colloidal matter.

Now, it is easy to say "filter out the colloids" but actually to do it is another matter. Colloidal matter is so finely divided that it will run right through an ordinary filter. Therefore, an ultra-filter must be used. The accompanying illustration shows the battery of Dawson filters used in these studies. The filter proper is made of a nitrocellulose film, prepared by spreading a thin layer of collodion on the surface of mercury in a glass dish and allowing it to "harden" to a film, which constitutes what is technically known as a semi-permeable membrane. This membrane will filter out colloids—but it is a long, slow process, and must be carried out under a vacuum. From three to five days of continuous operation were required for the ultra-filtration and subsequent washing of the colloidal material.

It was found that dark-colored honeys, such as a "diet" of buckwheat produces, ran as high as 1 percent of colloidal matter. Light honeys, such as those from clover and orange, ran less than 0.1 percent of colloids. These colloids, which are the primary cause of turbidity in honey, were found to consist largely of proteins, emulsified wax particles, pentosans, and inorganic constituents. The frothing and caramelization of honey upon heating were found to be materially decreased when the colloidal matter had been removed.—*A. E. B.*

Dry-Ice for Spotting Tanks and Machinery

AN interesting method for placing heavy machinery or equipment has been used with success by the engineer of a large ice cream plant in New York City.

The problem involved was the spotting of a rectangular welded steel brine tank weighing 6500 pounds on a flat foundation. The tank was fabricated on wooden cribbing placed so that all parts of the tank were accessible for welding.

Six blocks of dry-ice (solid carbon dioxide), each a 10-inch cube, were next evenly spaced on the foundation. The tank was moved approximately into place and lowered by jacks until it rested directly on the dry-ice. At this stage the friction between the tank bottom and the dry-ice was so slight that the entire tank could be moved into exact position by one man pushing against it. It was then blocked to prevent any lateral shifting, and allowed to settle to position as the dry-ice melted.

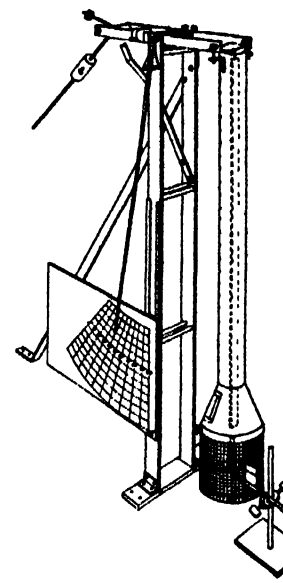
The method is believed to be applicable to lowering all kinds of heavy equipment where space is cramped and where overhead crane facilities cannot be had.

A similar procedure has been used before with ordinary ice but the great advantage in using dry-ice is that the dry-ice evaporates without leaving the mess that follows use of water ice.

How dry-ice was used in spotting a heavy tank

Fire Test Adopted As Standard

A FIRE-TEST tube apparatus developed by the United States Forest Products Laboratory, Madison, Wisconsin, and accepted as a test instrument by institutions



In the fire-test tube apparatus, the material under test is suspended in a tube over a "standard" gas flame

conducting research on fire retardants for wood in this country, also meets the requirements of German engineers.

The fire-test tube was developed at the Forest Products Laboratory as a necessary preliminary to the Laboratory's studies of fire-retardant chemicals. It has met a need of American testing laboratories for a convenient and reliable standard apparatus for testing the effects of fire on chemically treated wood. The tube, pictured on this page, shows temperature, loss of weight,

(*Please turn to page* 272)

CURRENT BULLETIN BRIEFS

RELATIONS BETWEEN CUBA AND THE UNITED STATES, by Juan Andres Lliteras, and RELATIONS BETWEEN CENTRAL AMERICA AND THE UNITED STATES, by Dana G. Munro (International Conciliation, January, 1934, No. 296), gives information about such hard-to-locate subjects as the Platt Amendment. *Carnegie Endowment for International Peace, 44 Portland Street, Worcester, Mass.—5 cents.*

WILD FLOWERS IN KANSAS (Volume LI No. 204—B) is a pamphlet of 293 pages, by Frank C. Gates, with 448 drawings by Mrs. Albert Dickens. The Department of Botany of the Kansas State College answers more letters and questions pertaining to the flora of Kansas than it does on any other subject. No satisfactory book has heretofore been available to the layman who wishes to learn about the wild flowers of Kansas. For copies apply to *J. C. Mohler, Secretary, Kansas State Board of Agriculture, Topeka, Kansas.—Gratis.*

RENSSELAER POLYTECHNIC INSTITUTE (Engineering and Science Series No. 45). This pamphlet deals with Amos Eaton, author, teacher, investigator: the first laboratories in any country for the systematic individual work of students in chemistry, physics, and botany: B. Franklin Greene and the reorganization in 1849-50. *Rensselaer Polytechnic Institute, Troy, N. Y.—Gratis.*

DARDELET THREAD HANDBOOK. This book of 220 pages contains much theoretical and practical information relative to the Dardelet thread, other thread forms, and thread-locking devices. There are also a number of tables which are not usually found in a single handbook. The Dardelet thread is designed to provide an efficient locked connection between a bolt and nut. This connection is produced without undue torque effort. *Dardelet Threadlock Corporation, 120 Broadway, New York, N. Y.—$2.00.*

HEALTH THROUGH THE AGES, by C.-E. A. Winslow and Grace T. Hallock, is intended to give boys and girls of high-school age a sense of the agelessness of man's search for health. It traces through various historical periods the story of how man has learned not only to protect his own body but that of his neighbors. One copy for each classroom. *Metropolitan Life Insurance Company, New York City.—Gratis.*

THE ANGLO-FRENCH MICRO-RAY LINK (Electrical Communication, Volume 12, No. 3, January, 1934). This communication system between England and France represents the shortest wavelength radio telephony link in regular commercial operation today and may be considered as heralding an era in which the privacy, efficiency, and reliability of micro-ray waves will be exploited to the full. *International Telephone and Telegraph Corporation, 67 Broad Street, New York, N. Y.—75 cents.*

THE AMATEUR ASTRONOMER

Conducted by **ALBERT G. INGALLS**

WE have been accused of publishing in this column too many descriptions of telescopes made by amateur telescope makers, rather than other more advanced, specialized matter pertaining to the hobby of telescope making. We admit the justice of the accusation and have gone easy on such matter for the past half year or so. But we have so many of these descriptions on hand and unpublished that we shall

Callum's reflector

run off a few in order to make a hole in the pile. First, however, some odds and ends:

THE new aluminized mirrors have been acclaimed as most satisfactory by several who have had the job done. A dozen have asked us for "complete instructions" for doing this job themselves. The February number of *Publications of the Astronomical Society of the Pacific* contains the data, by Professor John Strong of the California Institute of Technology—the man who made the process what it is today. "The data," we say, but the published data *do not* include the six months of grief involved in teaching the temperamental apparatus to perform—the "period of adjustment," a term usually applied to the first year of marriage and as aptly applied here.

The Bureau of Standards has recently prepared data on another cantankerous job—casting speculum metal. 'Tis said by some that here, too, the correct procedure is to read all about it and then not try it.

Now that winter is approaching—in the antipodes—we suppose somebody in Admiral Byrd's expedition will be making a telescope in the long Antarctic night. We have never learned who. Just before sailing, Admiral Byrd requested a copy of A.T.M., and got it. Who the TN in his party is, we can't say. Has any reader a notion?

OUR mention of photo-electric guiding in the February number brought out the fact that the idea had already been worked on by not a few. Noël Deisch, 908 G St., N. W., Washington, D. C., states that an article on the same subject appeared in *Zeitschriften für Instrumentenkunde,* November, 1929, and in *Revue d'Optique* for December, 1931; while Samuel Wein, 2065 Croston Avenue, New York, cites a paper in *Physikalische Zeitung* 1905 (p. 838), and states that he wishes to co-operate in this problem with interested workers. We have known for almost a year about the research of one worker on this apparatus but he wishes us to keep his results under our hat until his equipment is entirely freed from bugs—which it is said to be now, or relatively so.

WE have been flirting with the idea of starting a new magazine—a small one of course, at least at first—for the amateur telescope maker, and sent out 480 feelers to that many purchasers of A.T.M. selected at random, enclosing in each case a self-addressed stamped reply card. Of the 480 cards, 185 have come back, and of these 167 are favorable to the idea of organizing a society for amateur astronomers and telescope makers and publishing an organ. On the basis of this we either shall or shall not undertake it! (Tell you later.) The names suggested for the society and for the magazine range from the sublime to something else. The most pleasing return came from that staunch old telescope and spectrohelioscope maker, Henry B. Prescott of Wells River, Vermont, who enclosed two one dollar bills, making him potential subscriber No. 1, and said "Let's go." We have already spent his two dollars (embezzled it) so it looks as if we were morally obligated to start the magazine. (By the way please don't emulate Prescott—just yet—for we lack a technically correct way to dispose pro tem of such two dollar bills.) Our tentative idea is a format like that of the *Readers Digest,* but a thinner magazine, of course, for it takes years to build up a magazine to an armful, and this just happens to have exactly the dimensions of A.T.M. Accordingly—why not make the magazine uniform typographically with A.T.M. and, as it would contain all the advances, regard its bound volumes in the light of new editions of A.T.M.?

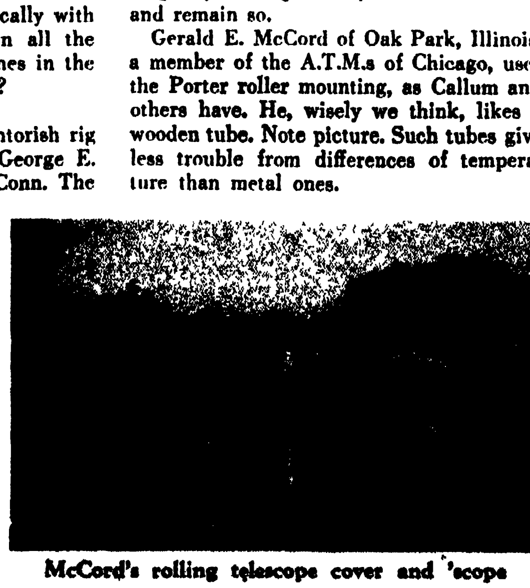
A DECIDEDLY neat and inventorish rig for a telescope is that of George E. Meyers, 106 Ann St., Hartford, Conn. The pictures almost explain themselves. The eyepiece may be turned to any position and locked there by means of the large knurled ring. This is the best solution of a bothersome problem we have ever seen. Meyers' mirror cell is equally ideal, permitting micro-adjustment without loss of alinement. It is like the one shown in A.T.M. page 449, which also screws in.

The three remaining telescopes shown are similar in appearance—two of them in principle. The first is by William Callum, secretary of the Amateur Telescope Makers of Chicago, and he states that it is a copy of Eliason's, shown on page 386 of A.T.M. It has an 8-inch aluminized mirror of $f/8.25$. The base is of steel, the tube of aluminum. The declination slow motion, on the side, is a new idea and is within reach. It consists of an arm which clamps to the trunnion supports, and which is controlled by a wheel running on a bent threaded rod. It can be set to 10 minutes of arc. Callum says the Chicago group has 53 members and that they are "as enthusiastic a bunch of nuts as you will meet anywhere outside of certain institutions which we will not mention." However, a good recipe for

Meyers' head rig and cell

longevity is to get nutty over some hobby and remain so.

Gerald E. McCord of Oak Park, Illinois, a member of the A.T.M.s of Chicago, uses the Porter roller mounting, as Callum and others have. He, wisely we think, likes a wooden tube. Note picture. Such tubes give less trouble from differences of temperature than metal ones.



McCord's rolling telescope cover and 'scope

THE Rev. Cyril E. Martin of the United Church Manse at Preeceville, Saskatchewan, writes:

"I was making my usual round of pastoral calls," he writes, "when I happened upon a copy of the SCIENTIFIC AMERICAN, and there learned that it was possible for even a 'sky pilot' to build his own astronomical telescope. I resolved to try my hand at telescope making. An order for material was sent, a copy of 'Amateur Telescope Making' was obtained and work was begun.

The Rev. Martin's telescope

"I had almost completed the polishing process of the mirror when I cracked it while warming it in making a lap. Work was held up for another month while another disk was sent for. This time I had better luck, the mirror was parabolized, set in its cell, and ready for my first view of the moon. I shall never forget that night. While the neighbors were sleeping I was aiming my six-inch at the moon. With trembling hands I adjusted the eyepiece, and that which was first a globe of light started to define itself until the craters and the mountains stood out clearly. Next day the mirror was silvered and next night the neighbors gathered from far and near to look at the moon for the first time through a telescope.

"The polar axis is a piece of 3½-inch shafting which revolves in two six-inch ball bearings. To this shaft is attached a wheel 24 inches in diameter. A worm gear is cut in the edge—this was done in a lathe with only a 9-inch swing, by placing a tap in the chuck and bringing the edge of the wheel against the tap, so that threads were cut. The hour circle markings were made on an aluminum strip and bolted around the edge of the wheel. To the wheel is bolted and braced the fork in which the telescope is swung. You will also note the two Ford brake drums through which the trunnion passes. Between these two drums is a disk of leather which serves as a clamp to hold the tube in declination, when the wheel, which can also be seen, is turned. The whole thing gives excellent results.

"The clock was made from an old Edison cylinder phonograph motor, the spring being replaced by a weight. This will keep an object in the field of the eyepiece for about half an hour."

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 268*)

and extent of flaming or glowing on a 40-inch strip of wood subjected to a standard flame for a standard test period. The tube or chimney with specimen inside is swung from a beam and counterbalanced. Percentage loss of weight of the specimen is self-indicated by the pointer and scale.

New Method of Dehydration

VEGETABLES may be dehydrated in one third the time ordinarily required with a method developed by Berthold G. Freund and tested by Prof. Charles W. Thomas, chairman of the subcommittee on drying of the process committee of the American Society of Mechanical Engineers, according to *Food Industries*. The process is said to retain the vitamins, so that the dried product is equal to the fresh in food value.

With the Freund-Thomas method, the vegetables are revolved rapidly in a draft of warm air, the temperature of which does not rise above 90 to 95 degrees, Fahrenheit. The rotary movement throws moisture off the surface through centrifugal action, simultaneously extracting the moisture from the inner cells.

Fruits, meats, fish, and cheese can be dried in this way.—*A. E. B.*

The Mystery of the "Cyclops"

WHEN the naval collier *Cyclops* disappeared without a trace on her homeward voyage from South America to the United States during the World War, theories as to the cause of her disappearance were many and varied. These have been discussed time and again in the newspapers so we shall not repeat them here. The latest theory, which seems more plausible than most, is quoted below from an article by Will Talsey in the magazine *Our Navy*.

"It will be remembered," relates the naval informant, "that during the war the sweepings of the rackets joined the navy to escape the army draft. There were in the personnel of some of the American ships specimens of the toughest hombres it has been my privilege to know; former convicts, thugs, burglars, and crooks of all kinds. Don't let me mislead you into thinking they were more plentiful in the navy than they are in any city in the land. They weren't. But in some mysterious manner a group of these tough guys got into the crew of the old *Pittsburgh*, an armored cruiser. These racketeers preyed on their fellow enlisted men until they created a reign of terror amongst them. They became so bold that they followed their fellow seamen to the paymaster's office and forced them to turn over their pay envelopes as soon as they drew them. They exercised terrorism through beatings, threats and worse, to such an extent that no one dared to tell the officers what was taking place. A report meant death—thrown overboard. This condition of affairs persisted until this motley gang of criminals became so bold as to lay plans to murder the officers and take over the ship. But here is where they reckoned wrong for the of-

ficers uncovered the plot, discovered the reign of terror amongst the enlisted personnel, and had them all arrested.

"The *Pittsburgh* in those days was the flagship of the squadron sent to Central and South America to establish friendly relations for our side in the war. When it came into the harbor of Rio it found the *Cyclops* about to weigh anchor and start home to the States. Since the *Pittsburgh* was bound on its mission and that meant carrying the mutineers half way around the world before placing them in a naval prison, it transferred the prisoners to the *Cyclops* for shipment home, prison and death.

"Perhaps as the *Cyclops* neared the United States the officers eased down on their vigilance. Remember these prisoners were wily, cunning and desperate men, determined not to have their lives and/or liberty taken away from them without a violent try at resistance. A guard enters the room in which the prisoners are confined. He is overpowered. The thugs are at liberty. They get possession of his weapon, kill other sentries and get their weapons. They had already perfected plans to sink the ship and escape in boats in the confusion. So they make their way to the seacocks. They open them and water pours into the low laden ship. The engine room is flooded before the officers and crew know what it is all about. The dynamos are disabled and the radio operator hasn't the electric power to send an SOS. With such suddenness has it all happened, that the heavily laden old ship sinks too rapidly for the mutineers to swing the boats over side and escape; the tremendous suction caused by the *Cyclops'* fast sinking pulled all down with it. Maybe some of the mutineers did get away in a boat. Maybe they landed on the beach of one of the innumerable sponge fishing villages that dot the Caribbean. Yes, maybe some are even there today for there are many out-at-the-heels disreputables strewn from Havana to Tela of whose past nothing is known."

Although the last explanation appears to be the most plausible of all, yet it is a guess. What happened to the *Cyclops?* That was the question asked by the United States Navy and the public back in 1918 and 16 years later it still remains an unanswered question. It remains the greatest mystery of the World War.

Radioactive Textiles

"MY dear, you are simply radiant in that gown!" This remark (guaranteed to "go over big" with any woman) may come to be literally true, according to reports from abroad where experimenters have produced a rayon material which is radioactive. This result is achieved by dissolving a minute quantity of radium sulfate in the rayon spinning solution, before the thread is manufactured. Fabrics giving off mild radiations are said to result from the addition of 0.02 percent of the radioactive substance to the solution. Higher proportions of radium salt naturally render the fabrics more intensely radioactive. Apparently repeated wearing and washing has no appreciable effect on the radioactivity of the fabric.

Just why anyone should want a radioactive silk dress is not clear to this writer. Moreover, with radium at present prices,

it is an open question whether anyone could afford such a luxury. But no doubt a good advertising campaign could convince the ladies that they can never capitalize their full charm until their silken garments broadcast gamma rays.—*A. E. B.*

Alcohol Banned in Candies

THE repeal of the 18th Amendment did not abolish that stringent clause in the Food and Drugs Act which defines as adulterated any confection or candy which contains intoxicating liquors, according to J. W. Sale, Federal Food and Drug Administration. This clause of the law was designed largely for the protection of children who relish candy and eat quantities of it. The provision has been stringently enforced and, declares Sale, will continue to be stringently enforced. The Federal Food and Drugs Act states that confectionery is adulterated "if it contain***any vinous, malt or spirituous liquor or compound."

How Lightning Produces Thunder

IT is now thought that the sound of thunder is caused largely, if not entirely, by a sudden increase of pressure due to heating, dissociation, and ionization along the path of a lightning stroke, says M. G. Lloyd, Chief, Safety Standards Section, United States Bureau of Standards, writing in *The United States Daily.*

The energy of a stroke may amount to 10.8 or 10.9 watt-seconds, of which the greater portion is expended in heating the air. If the path is assumed to be a foot in diameter and a mile long, 10.8 watt-seconds would heat it to about 650 degrees, Centigrade, with an increase of pressure of about two atmospheres. The dissociation would add to this by increasing the number of gas molecules.

This increase of pressure, which may in reality be much greater than two atmospheres, takes place very abruptly and is sufficient to account for the ear-splitting crash which accompanies a near-by flash of lightning.

Chemistry Aids "Talkies"

FALSE teeth and phonograph records, two articles of widely different utility, are produced today in a much improved form as a result of the chemists development of the synthetic substance known as vinylite. This ubiquitous material, one of the large and growing family of synthetic resins, is made by the combination of two organic chemicals, vinyl chloride and vinyl acetate. According to Carleton Ellis, who describes it in *Industrial and Engineering Chemistry*, it is available as a molding powder in various colors and has been used for wall panels and doors, which are probably the largest single-piece press moldings ever made from a synthetic resin. The compositions have been tried experimentally for many articles, including molded jars, automobile steering wheels, and translucent panels for lamp shades and indirect lighting fixtures.

In the sound record industry, a 4-ounce Vinylite record for motion picture theaters now does the same job that formerly required a shellac record weighing 20 ounces. The reduction in size from 16 to 12 inches is

diameter was made possible by the greatly increased strength and flexibility of the new material as well as by its finer texture. Other types of records have been made from this resin. The versatility of vinyl resins in this field is illustrated by the successful substitution of non-inflammable Vinylite for celluloid in disks for home-recording. Vinylite can be handled on the same equipment used for shellac compositions, with only minor changes in technique. The total production to date, including home recording, motion picture, and all special Vinylite records, is probably about a million records.

Artificial dentures have been made from a number of materials: hard rubber, celluloid, Bakelite, and so on. Denture compositions of vinyl resin containing only a small amount of pigment and having a very natural appearance have been prepared which are adapted for this application. They are tasteless, odorless, and unaffected by continuous exposure to moisture, dilute acids, and alkalies.

Polystyrene, a resin related to vinyl polymers, shows great possibilities, but at present its cost of production is too high to warrant any extensive use. The resin is water-white in color and has the highest insulating power of any available synthetic resin, higher even than shellac. Some samples of polystyrene which have been examined are so tough as to require a hammer and anvil to break them.—*A. E. B.*

A Bee-Sized Bird

HUMMING birds are commonly considered to be about the smallest of the feathered family—at least in this country. In Haiti, however, Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution, has discovered a tiny bird, no bigger than a good-sized bee. This insect-like bird is quite pugnacious and does not hesitate to attack birds as large as a mocking bird.

A Flower That Eats Insects

A BOTANICAL curiosity which can be grown in the home has recently appeared in a metropolitan store. This plant is called the Darlingtonia (*Chrysamphora darlington*) and in shape resembles the hooded cobra of India. The blossoms are brilliant purple and crimson; a fluid exudated from the flower attracts ants, flies, and other insects, which the plant promptly consumes. In an advertisement of this flower an inspired copy writer added the following note: "If kept in a room free from insects it enjoys an occasional particle of meat!"

INDUSTRY—RESEARCH

(*Continued from page 243*)

the huge stores of these materials as assets, when they cannot possibly be unless they are moved from the warehouses and into the channels of trade. Lately, we are changing some of our old ideas and setting up new conditions to fit our times for production and distribution. As soon as these ideas are more firmly established we will go ahead again at full speed.

If you would sit down and analyze the situation, you would find out that the old maxim, that there is nothing so constant

as change, forbids and prevents ever crystallizing anything. When you are discussing science and business you are discussing the process of change, and nothing else.

Modern business has had its department of finance, its departments of production, sales, advertising and so forth, but until very recently it has not had a systematic department of change making; and that is the new factor which is being introduced more and more into business, from the board of directors down. Business will change whether you want it to or not and so it is necessary to study these changes and be ready for them with a new or improved product.

Most people think of a research department as a test tube or microscope or some scientific instrument of that sort. It is nothing of the kind. It is more a point of view from the management standpoint. Even in the laboratory, research is not done in a test tube or under a microscope. It is done in the mind of some individual long before it gets to the test tube stage.

The research department should keep in close touch with the trends of its own business and, what is just as important, the trends in other industries. It is only in this way that the outstanding things that are likely to influence your own industry can be followed. You are always too late with a development if you are so slow that people demand it before you yourself recognize it. The research department should have foreseen what was necessary and had it ready to a point where people never knew they wanted it until it was made available to them. If this is not done, the business slumps until it takes a heroic method to get it back to where it should be.

THERE has been a great deal of failure in research in industry for the reason we have gone out and hired some technician from some reliable organization and set him off in a corner and said, "That is our research department." That is not enough. You have to analyze your business to find out what it needs and then give the technical man a specific problem. He cannot be a superman and work you out of your difficulties in a day or week.

But industries are fast beginning to realize that some department must look ahead and plan for the future. So research sits in the executive conferences and is considered just as fully as manufacturing, marketing or any other problem. Instead of being put in some dark, unused corner of a factory building it is housed as well as the other necessary departments of business where contacts with production, sales and financial executives are easily made. With management open-minded to the ideas originating from research the future of an organization is just as assured as if it were covered by an insurance policy against becoming stagnant.

The first thing necessary is for management to recognize that change is inevitable. It is then the job of the research department to find and recognize the factors that are going to make it change, and then have them digested by the entire organization before the public demands the change. The closer contact of research executives and other executives in business is bound to result in a more complete program of advancement.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Inventions and Industry

IF America wants a Five Year Plan that will put her ahead five centuries, . . . let her cease drafting new laws for two or three years, while a few thousand genuine scientists who are not Yes-Men for corporations ascertain which unexploited inventions and discoveries might be quickly turned to account, without too greatly disturbing affairs. There are hundreds of such, many of them pigeon-holed in patent files or else lying around unused for lack of financial backing. Let our political pundits finance the free experimenting with new ideas, no matter how remote and abstract they may appear to laymen; the only proviso being that a committee of scientists and engineers uninfluenced by slick profiteers passes judgment on the ideas as worthy of inquiry.—From "A Short Introduction to the History of Human Stupidity" by W. P. Pitkin.

Pictures on Labels

IT was recently held by First Assistant Commissioner Kinnan that where a registration was sought for a label containing the picture of a woman, either it was error to require a statement that the representation is fanciful or, if the contrary be true, that the consent of the individual be filed, where there was nothing to indicate that the picture was that of a living person.

In his decision, the First Assistant Commissioner said:

"It may, however, be proper to state that the requirement has been made from an analogy to the statutory requirement in connection with the registration of a trade mark including the portrait of an individual.

"Where, as here, the officials of this Office have no basis for considering that the picture in the label is that of any living person, it is believed unnecessary for this Office to investigate the matter. The examiner is authorized to withdraw his requirement."

Inexpensive Protection

A MANUFACTURER was amazed recently when his attention was called to a newly issued patent relating to his industry. "Why, we have been doing this for the last 15 years," he said. "Why did the government issue a patent for it at this time?"

He then drew out from his desk a small printed pamphlet which he issued to the trade many years ago to confirm his statement.

Upon being asked whether he sent a copy to the Patent Office he said, "Why no, why should I? There is no law requiring it, is there?"

This is a typical case which occurs quite often. The manufacturer usually operating on a small capital to begin with devises a new machine, process or article. He does not proceed to protect them by a patent and hastens to invest capital, equipment, and advertising effort in his new development. He may print some interesting trade literature describing his product and send it out to the trade.

The chiseler then comes along, files a patent application for the new development. The Patent Office has no literature in its files which it can cite to anticipate the claims of the application and it does not have any records of all the trade practices in the industry owing to lack of appropriations from Congress for this particular purpose. The patent therefore issues much to the chagrin and annoyance of the true inventor.

The moral is that all new developments should be safeguarded by patent protection but if such protection is not desired for diverse reasons the simple precaution of promptly sending one or two copies of the printed trade literature to the Patent Office would serve the purpose in many instances. The Patent Office could then cite the publication against the chiseler and thus spoil his game. Without having this information the Patent Office could not possibly protect the original inventor.

The function of the Patent Office is not only to issue patents but also to prevent their issuance to unwarranted persons in order to protect the public from harassing monopolies. Manufacturers and all other interested persons should therefore assist the Patent Office by sending all the technical publications, reprints, bulletins, trade catalogs, circulars, etc., which they issue and thus keep the Office informed in regard to their new developments. They should also co-operate by sending in any specially prepared bibliographies, digests, and summaries of the literature on particular subjects which are not ordinarily available.—*Journal of the Patent Office Society.*

Bromo-Quinine Trade Mark

IT was recently held by First Assistant Commissioner Spencer that The Paris Medicine Company, of St. Louis, Missouri and Wilmington, Delaware, is entitled to register, under the ten year clause of the Act of February 20, 1905, the notation "Bromo-Quinine" as a trade mark for medicinal tablets for relief of colds and so on.

The ground of the decision is that the applicant had had the required ten years use and that the mark can function as a trade mark.

In his decision, after noting that "Bromo" and "Quinine" are recognized medical terms indicating that the product, as it does, contains both a bromide and quinine and that descriptive marks are registered under the ten year clause and that the showing had been made that the applicant had the ten year use and the mark has always indicated to purchasers a source of origin or manufacture, the First Assistant Commissioner said:

"It is urged by the Examiner that the terms 'Bromo' and 'Quinine' being recognized medical terms cannot indicate origin or ownership but merely serve to specify or describe a certain product. . . . This mark may come under the prohibition established in such cases . . . but, if so, such fact is not disclosed by the record in this case nor does it fall within the scope of judicial knowledge or inquiry of this tribunal.

"Under the circumstances this tribunal is disposed to adopt the contentions of the applicant and accordingly hold the mark registrable."

Damascus Trade Mark

IN *ex parte* Damascus Steel Products Company, First Assistant Commissioner Spencer held that the company, of Rockford, Illinois, is not entitled to register, under the Trade Mark Act of February 20, 1905, the term "Damascus" as a trade mark for knives and other tools made of steel.

The ground of the decision is that the mark is merely geographical or descriptive.

In his decision, after noting that Damascus is the name of ten villages in this country as well as the name of an ancient city in Syria and that the dictionary defines it as indicating steel of superior quality, the First Assistant Commissioner said:

"The applicant is between the horns of a dilemma. If the term is employed in its primary sense, it is geographical and hence barred. If reliance is placed upon its secondary meaning, it is clearly descriptive of the 'quality of such goods' and similarly barred. . . ."

Deafness "Cure" Curbed

ADVERTISEMENT and sale of an electrical device called "Mears Airosage" as a cure or relief for deafness, is prohibited by the Federal Trade Commission in an order to the Mears Radio Hearing Device Corporation, New York City. "Hearing has been restored by the use of Airosage after 20 years of extreme deafness," the company had said in its advertising describing the device.

Findings of the Commission after taking testimony in the case are that treatment by use of the device is not scientific but is dangerous.

The company was ordered to stop representing that "Airosage" and "Mears Ear Oil" will cure or relieve deafness or head noises, or that use of the former with or without the ear oil is scientific or proper treatment for deafness or head noises, or that the oil has therapeutic value.

Books SELECTED BY THE EDITORS

THE LIMITATIONS OF SCIENCE

By J. W. N. Sullivan

REVIEWS of this book published in various scientific magazines here and abroad show that it is being regarded generally as one of the outstanding books of the year. It is mainly a book of criticism concerning the philosophy of science and the scientific outlook, the connections between religion and science, and so on. It also points out the limitations of science—what science can do and cannot hope to do. The style is lucid but the book is not for lightweight readers, having a large content of material for the provocation of thought.—\$2.95 postpaid.—*A. G. I.*

BUMBLEBEES AND THEIR WAYS

By O. E. Plath, Prof. Biology, Boston Univ.

A COMBINED popular and scientific account of the life and ways of the familiar bumblebee, written by a scientist who makes their study his summer hobby. Quite plainly the observation and study of these big good-natured fellows (or rather, ladies) provides as fascinating a scientific hobby as that of the domesticated honey bees. How many of us know, for example, that there are not one but a dozen common species of bumblebees in our fields?—\$4.20 postpaid.—*A. G. I.*

HEWITT'S HANDBOOK OF STREAM IMPROVEMENT

By Edward R. Hewitt

FISHERMEN and other nature lovers will find much of interest in this book. It is an accepted conclusion that fish in the streams of the United States, placed there in the large majority of cases by stocking programs, do not have an even chance for obtaining sufficient food to sustain life. The author gives his views of the situation, and how it may be changed by stream improvement. A practical book based on practical experience.—\$2.65.—*A. P. P.*

T N T

By T. Swann Harding

"THE argument of this book is not to defend Government or even the NRA as an ideal dictator destined to produce Utopia. It is to show that the social business of the Federal Government is managed more effectively, more intelligently, and more competently than the business carried on by private enterprise under the profit incentive. Furthermore it is the contention of the book that only Government can effectively redistribute income so as to produce the broad base of widely diffused consumer purchasing power upon which mass production depends. If private enterprise is able to elude the guiding hand of the Government, not only will the NRA fail, but the whole structure of our civilization will inevitably collapse."

The author has contributed several articles to SCIENTIFIC AMERICAN and his style is dynamic and lively. He has a lot to say and he says it fearlessly.—\$2.90 postpaid.—*A. G. I.*

THE DISCOVERY OF THE ELEMENTS

By Mary Elvira Weeks, Asst. Prof. Chem. Univ. Kas.

A COMPACT 355-page detailed account of the discovery of each of the 92 chemical elements, each discovery being dealt with both in its scientific and its historical (human) aspect. This is the first time all this widely scattered data has been brought together. It is a rich mine of elementary chemical lore, informatively but most readably written and copiously illustrated.—\$2.15 postpaid.—*A. G. I.*

THE AMATEUR MACHINIST

By A. Frederick Collins

THE author has produced a whole shelf full of "handy how-to-do-it" books. The present volume deals in a simple manner with hand and bench tools, the common lathe, the screw-cutting engine lathe. There are chapters on mechanical drawings and the finishing of metal work. The cost of most articles is given.—\$2.15 postpaid.—*A. A. H.*

PIRATES OF VENUS

By Edgar Rice Burroughs

IF you can take your scientific fiction with at least the proverbial grain of salt, and without getting too serious about it, here is a book for you. It is crammed full of adventure and excitement, all being built on a semi-plausible background. Briefly: The central character designs a rocket and is shot at Mars. A miscalculation carries him past this planet and he lands on Venus where he has many strange adventures—and of course a love affair—amid the Venusans and their weird animals and mile-high trees. Oddly enough, he does not marry the girl! The author supplies a clever background of language and customs of his imaginary inhabitants of Venus.—\$2.00 postpaid.—*A. P. P.*

AUTOBIOGRAPHY OF A BIRD LOVER

By Frank M. Chapman

THOSE who are interested either in birds or conservation, and many others, will find fascinating reading in this life account of the world's leading bird lover, Frank M. Chapman of the American Museum of Natural History and editor of *Bird Lore*. It will take them far afield to countries where both birds and adventure abound. Primarily this autobiography is not about birds but about the rather romantic career of a remarkable man. Perhaps this is why the reviewer found himself reading for fun rather than duty, though he has no interest in birds, for the book carries the reader along with its current of ever-varied narrative. 384 pages, illustrated.—\$3.90 postpaid.—*A. G. I.*

CAN WE LIMIT WAR?

By Hoffman Nickerson

MR. NICKERSON answers his own question. He believes war is inevitable but that it can be limited. Pacifists may disagree with him on the one point but all of us hope he's right on the second. Having read the impressive evidence on the impossibility of the perpetual peace of idealists as set forth in Stockton's "Inevitable War," we consider Mr. Nickerson's contribution to the study of this vital problem logical almost to a fault and extremely impressive. "Can We Limit War?" is, indeed, a provocative study of the intimate relation between war and our social order, by an author who has been proclaimed our greatest military historian. 300 pages.—\$2.95 postpaid.—*F. D. M.*

THE TURNING WHEEL

By Arthur Pound

ALTHOUGH this book is obviously publicity material for General Motors, it is so well prepared and presented that it rates a definite niche of

its own in the history of the automotive industry. Everyone who can remember the cars of three, two, or even one decade ago will find this book to be one that will make absorbing reading, and at the same time will be informative. The author devotes the first chapter to the evolution of the automotive vehicle. He then considers the formative period from 1879 to 1899. From this point on is built up the background of the great General Motors Corporation as it stands today. The influence of a vast organization such as this on the general welfare and progress of the country is not to be dismissed lightly. The author tells the whole story and tells it in smooth, flowing, narrative style that makes for easy reading. 517 pages including valuable appendices, bibliography, and a comprehensive index. Well printed and illustrated. Bound in stiff covers.—$3.70 postpaid.—*A. P. P.*

BEHIND THE DOCTOR

By Logan Clendening, M.D.

REVIEWING some books is a downright bore—or it would be if boresome books were really reviewed in these columns. The reason why the books reviewed here are so uniformly praised is that those which bore the reviewers are not "selected" (see heading at top of page). Dr. Clendening, the author of "Behind the Doctor," is no book bore—just the reverse, he is the most yawn-proof writer of accurate, authentic popularized science in America today. His first book, "The Human Body," published in 1932, brought him instant fame, for he took a dull subject and breathed life into it so that his book became a scientific best seller. Now he has taken another supposedly dull subject, the history of medicine, and performed a greater miracle than he did before. There has been plenty of real drama in the growth of medicine —the discovery of anesthesia, of insulin, of germs, X rays, septic surgery, vitamins—dozens of discoveries. What Dr. Clendening has done is to ransack original sources—he is a practicing physician himself, no hack writer, and knows his background at first hand—and select the most dramatic and revolutionary events, then make his book entirely of these. It is in narrative form and mainly in dialog. It is as much about people as about things. This book lives in every one of its 444 illustrated pages. The volume is nicely produced—nice binding, paper, type.—$3.90 postpaid.—*A. G. I.*

JANE'S FIGHTING SHIPS

Oscar Parkes, Editor

NAVAL history having been made during the past year, this latest edition of a famous book by a noted authority has much to offer in the way of details and descriptions of fighting fleets. Many photographs of newer ships —such as the new U.S.S. *Ranger*— which have not been seen elsewhere, appear in its pages. A fresh feature in this edition is the summary of naval forces of the British, U.S.A., and French navies. Over 450 new illustrations have been added and the text has been thoroughly revised to show the innumerable alterations to tonnage, horsepower, secondary armament and complement, uniforms, and flags.—$18.00 postpaid.—*F. D. M.*

THE SINGLE WOMAN, A Medical Study in Sex Education

By Robert Latou Dickinson, M.D., and Lura Beam

THIS is the second volume of a series of advanced studies which are being published by the National Committee on Maternal Health, the first volume, entitled "A Thousand Marriages, a Medical Study of Sex Adjustment," by the same authors, having been reviewed in these columns in January 1932. Of the latter book the great psychiatrist William A. White said:

"To those who are interested in human beings—real human beings—not fictitious, imaginary human beings that stalk across the pages of most of our books that deal with their peculiarities, this book is a rare contribution. It tells the story of the vital concerns of human lives and their effects upon health in a simple, straight-forward manner, free from prejudice, prudery, and hypocrisy."

"The Single Woman" is also that kind of book. It is a scientific, medical study of the sex life of the single woman, as revealed in 1078 case records. It deals with the single woman's physiology and anatomy, her psychology, environment and social life, her conflicts and refuges. No comparable study of the single woman has appeared hitherto, because the case material gathered by Dr. Dickinson in 50 years of practice as a specialist is unique. The book should be of value to parents with adolescent daughters, to teachers and social workers, sociologists, jurists, ministers, and to all the intelligent, socially minded persons who believe that sound sex education is the necessary basis for a normal adjustment to life. 460 text pages.—$5.20 postpaid. —*A. G. I.*

THE MODEL MAKER FOR THOSE INTERESTED IN MAKING WORKING MODELS

Edited by W. Edmunds Spon

MODEL making is much more in vogue in England than in the United States, so we welcome this bound volume of a monthly publication, in usable form, accompanied by an index. The advertisements are all of American concerns selling material for amateur model makers.—$2.40 postpaid.—*A. A. H.*

THE CHEMICAL FORMULARY, VOLUME I

Editor-in-chief H. Bennett

THIS is a volume of more than 550 pages and contains thousands of practical formulas for making products in all fields of industry. It will serve as a valuable companion volume to our "Scientific American Cyclopedia of Formulas." The new book differs from our own in the inclusion of special substances which are the creation of manufacturers of various special substances and chemicals. The use of these new materials gives an improved or altogether different product. The formulas that have been issued in folder form have given our readers satisfaction, particularly in the line of cosmetics, automobile polishes, et cetera. Among some of the unusual formulas are: anti-fogging solutions; airplane "dope"; carbon suspensions, chlorine treatment, chromium plating, crease-proofing fabrics, and hundreds of others. Another volume is promised next year.—$6.25 postpaid.—*A. A. H.*

THE FRESH-WATER ALGAE OF THE UNITED STATES

By Gilbert M. Smith, Prof. Botany, Stanford Univ.

A BOOK for the amateur microscopist who is interested in the fascinating study of those multitudinous living forms of sub-visible life known as pond life and who wishes a reference source for identifying the various algae of this country. It is a large book of over 600 pages, with 449 illustrations showing the commonest of these tiny organisms, regarding some of which it is difficult to say whether they are plants or animals (forms probably reminiscent of the early times in evolution when plants and animals had not yet clearly differentiated). Each form is described in detail. There are preliminary chapters on their distribution and occurrence, their collection and preservation, and on their nature, evolution, and classification. This is not an elementary book, but as a reference book it should be in the library of every amateur microscopist. —$6.25 postpaid.—*A. G. I.*

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NINETIETH YEAR • ORSON D. MUNN, Editor

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Cover

THE photograph by R. T. Dooner, reproduced on our cover, shows a habitat group of a rare giant panda family which has just been unveiled in the Free Natural History Museum of the Academy of Natural Sciences, Philadelphia. The group includes a male, a female, and a young panda in surroundings reproduced from sketches and photographs made in Szechuan Province, Western China, by the Dolan-West China Expedition under the leadership of Brooke Dolan II. The background was painted by C. Clark Rosenkranz and the group was erected under the supervision of Harold T. Green.

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ACROSS THE EDITOR'S DESK

SOME astonishing results in telepathy have been attained in a series of experiments conducted by Dr. J. B. Rhine of Duke University. These experiments have been conducted over a period of approximately three years and results have been recorded in a precise and accurate manner. Throughout the entire series all disturbing factors were eliminated as far as possible, so that the results might not be vitiated by outside influence. Dr. Walter Franklin Prince, who was of great assistance to the other editors of this magazine in conducting their tests for telepathy, has prepared an article on the experiments at Duke University, in which he gives an excellent survey of the entire work. This article is scheduled for publication in our July issue.

●

EVERY once in a while the subject of rockets crops up in the daily press—rockets for interstellar flight; rockets for lunar exploration; rockets for sampling the upper air; rockets for intercontinental travel. This is at least evidence that some serious thought is being given to the subject of rocket propulsion in general and that a certain amount of experimental work is being conducted. In an article entitled, "What's in the Rocket?", G. Edward Pendray, President of the American Rocket Society, tells something of the work that is being done in various countries of the world, what may be expected of rockets constructed on various principles, and of rockets which are now being constructed for use in the near future. It may be surprising to most people to learn that rocket societies in various parts of the world have a total membership of between two and three thousand. Mr. Pendray's article will appear next month.

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AN intensely interesting and humanized story of one branch of research that is being conducted in an effort to combat the dread scourge of cancer is told in an article by T. Swann Harding scheduled for publication next month. Dr. Frederick S. Hammett, in a small and unimposing laboratory in Massachusetts, is performing and directing some of the most fundamental research on the cancer problem now being carried on in this country. Mr. Harding presents a masterly survey of the work which Dr. Hammett is doing and the things which he hopes to accomplish. The problem is difficult and its solution will be a long and tedious job. It is hoped, however, that research based upon principles established by countless experiments and observations will eventually lead to this solution and will free humanity from one of its most deadly enemies. So far the research has turned out according to expectation; only future findings can determine the exact value of the present work.

NEXT MONTH

¶ Dr. Walter Franklin Prince on a remarkable series of results obtained in telepathy tests.

¶ T. Swann Harding tells of an outstanding piece of research on cancer.

¶ G. Edward Pendray writes on the subject of rockets: What they have done and what may be expected of them.

COMING

¶ P. F. Valentine, of San Francisco State Teachers College: A philosophical article entitled "What is Personality?"

¶ George W. Kosmak, M.D., Editor, *American Journal of Obstetrics and Gynecology*, on "Why the High Mortality in Childbearing?"

¶ The viewpoint of the opponents of sterilization, written by a well-known Catholic, will be presented soon.

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DURING the past few months we have presented a series of articles detailing the methods used in laying out various types of sundials. In our next issue R. Newton Mayall and Margaret Walton Mayall, authors of the several articles on sundials already published, take up other phases of the subject. They discuss in detail various materials which may be used in the construction of dials, tell something of the inscriptions which are frequently used, and give a detailed discussion of the equation of time and its application to sundials. Those who have followed our articles on this subject so far will find the next one to be of outstanding interest.

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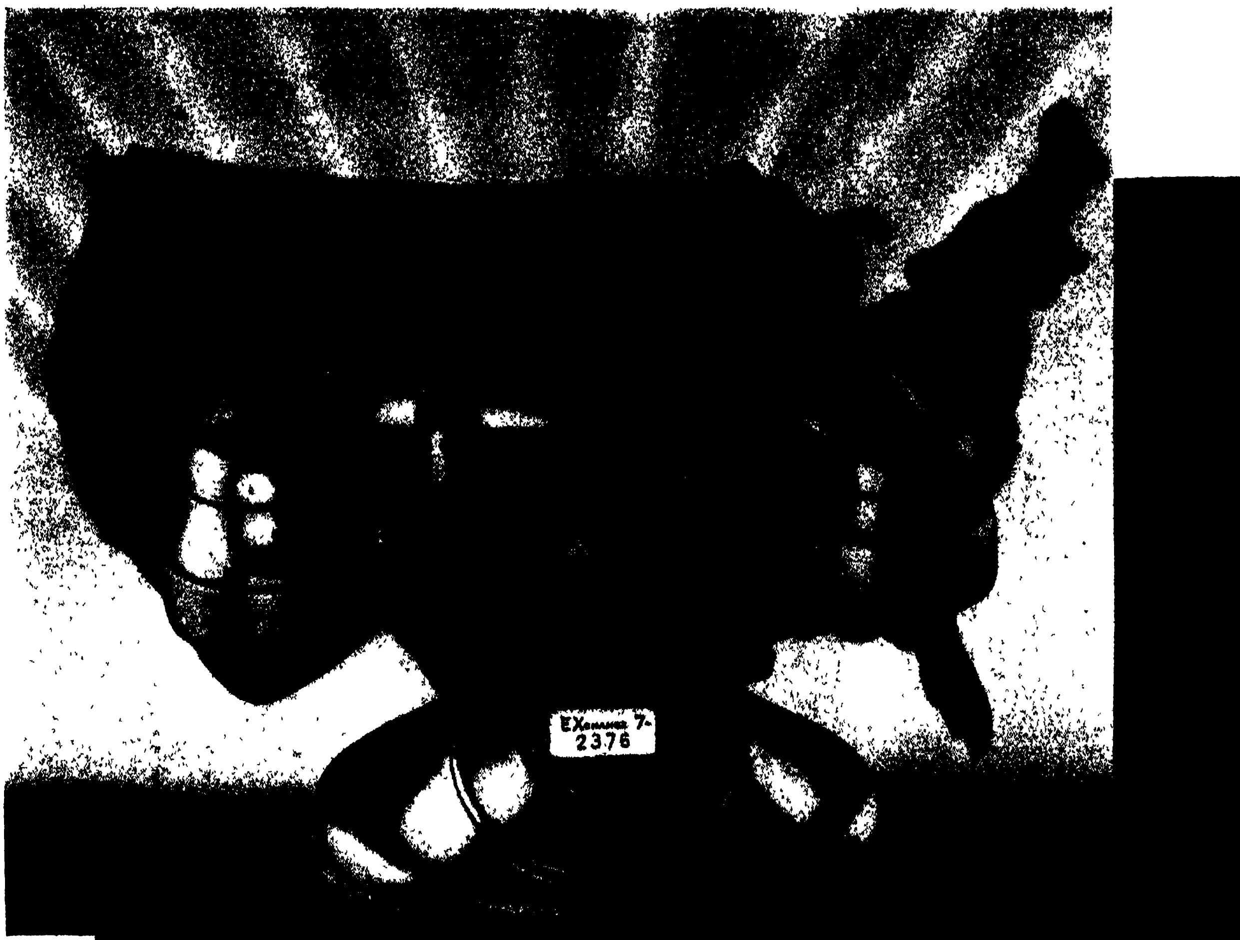
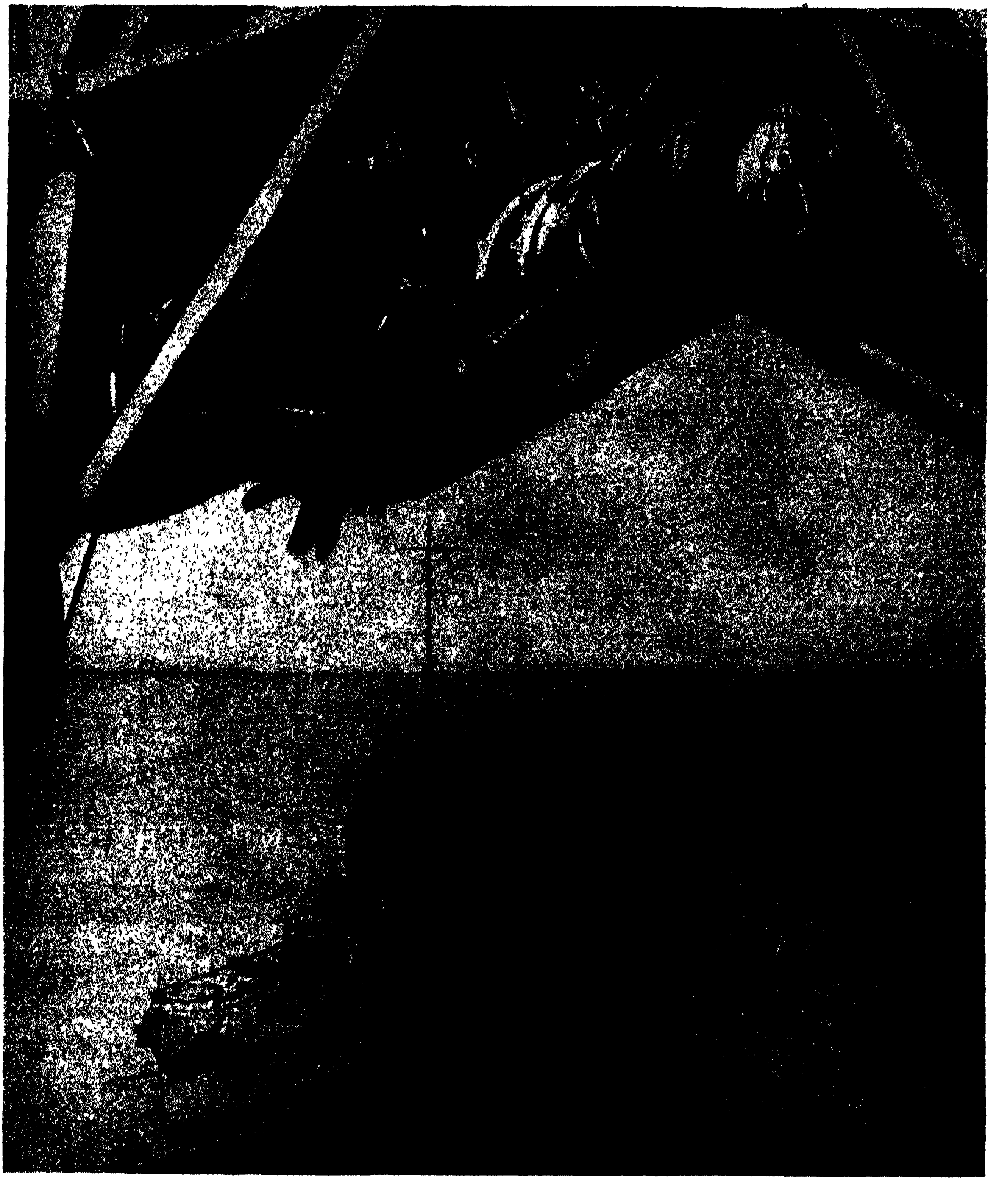
"I BELIEVE in sterilization of the unfit because it is the duty of medicine to prevent disease and this is one means of prevention, mental and otherwise. I believe it should apply to all mental cases, congenitals, drunkards, criminals, moral defectives. It is hoped that it will be successful in Germany, and most probably it will be successful. It eventually will come to all civilized countries as a means to get rid of the scum of humanity." Thus writes Dr. Adolph Lorenz, prominent Viennese surgeon, of a subject which is dealt with in an article starting on page 292 of this issue. A second article on the same subject, prepared by E. S. Gosney, President of the Human Betterment Foundation, will be published next month.

●

SPLITTING seconds with an unimposing crystal ring is one of the achievements of research in time keeping. All human activity and business are based upon time. Accuracy of time keeping is a vital factor in many industries and for these reasons any improvements which can be made in recording the positive time can immediately be put to practical use. The story of how crystals control time and of the important part which these crystals play in our daily lives is told in an article scheduled for publication in an early issue.

Editor and Publisher





MODERN WARSHIPS OF THE SEA AND AIR

A STRIKING view of a British bombing plane passing over the cruiser *Leander* during recent maneuvers of the British fleet in the North Sea. The huge aerial torpedo and its holding mechanism symbolize the potential destructive ability of modern airplanes capable of carrying heavy loads. The subject of such planes and their possibilities in offensive warfare against large cities is discussed by Professor Alexander Klemin in a note in the SCIENTIFIC AMERICAN Digest department of this issue.

IN the accompanying article Secretary Wallace states that the scientists have given the world vast new forces which sometimes help us but sometimes enslave us (as in war, or in machine exploitation), and that science, which has released these new forces, now owes it to the world to control them. Heretofore men of science have not done their research with any definite thought in mind concerning what others might later do with their discoveries. They work mainly from sheer scientific *curiosity*—it is fun to find out new facts about the universe.

It happens, however, that these same scientists (with certain regretted exceptions to whom the author alludes) are the world's little corps of very best minds—the exact thinkers—not over 100,000 strong all told. The greatest problem which humanity has to face at the present stage of its career—the raw half-digested stage of the young Age of Science—is the fact that most of the other 1,999,900,000 human beings are essentially unprepared to guide the powerful toy placed in their hands by the 100,000, as unprepared as a drunken man to guide a motor car. Yet do the scientists lead the world? No, it is the statesmen and politicians—representatives of the other 1,999,900,000.

Suppose, then, that a scientist were actually put in command, as the Secretary hints might be best. The first question we must ask is, would the 1,999,900,000 be wise enough to accept their own advantage, or would they slip back into the control of some inexact thinker better equipped with gift of gab to exploit the foibles of human nature? Could water be made to rise higher than its source? We wonder.

In any case, Secretary Wallace's discussion is provocative.

The SCIENTIST in an UNSCIENTIFIC SOCIETY

By HENRY A. WALLACE
Secretary of Agriculture

HAVING made possible material gains during this Century of Progress greater than in any other age, science ought now to be receiving the thanks and the homage of a grateful people. Instead, it is the object of indignant questions as to its value to society, and proposals for "holidays" on research are augmented by further proposals to turn the clock back to more hand labor, to fewer creature comforts, and to the presumably simpler life of our grandfathers.

To many scientists this state of affairs is very puzzling. Called out of their laboratories to contemplate the situation, they denounce these lay proposals as moonshine, as grotesque impediments to progress; and as they turn back to their researches they refer irritably to the ungratefulness and the stupidity of mankind. Which of course leaves the situation right where it was.

A more recent attitude, expressed in the attempt of distinguished scientists to prove that science really creates new jobs rather than more unemployment, or that it makes it possible for efficient farmers to make a profit with low prices, is not, I fear, a very effective answer to the present plight of the world. It is extremely difficult to argue five or ten million unemployed into jobs, or to ignore the fact that a million and a half farms have gone under forced sale since 1920. And of course it completely avoids the real issue; that is, whether science, having demonstrated its power to transform the world, ought not to have some responsibility, or at the very least some interest, in the social consequences of its handiwork.

I can understand the impulse which prompts scientists to defend science against the attacks of the uninformed: Science has achieved so many miracles for society, saved so many lives, made possible so extraordinary an advance in material living standards for so many millions of people, that it is disquieting to think that all the consequences of science can ever be other than good. Yet I don't see what basis we have for assuming that science can and does have only beneficial consequences. Is the product of man's curiosity inevitably good? Is there any reason for assuming that the end result of any enlargement of human knowledge must, perforce, be beneficial? It may be disturbing to realize it, but the truth seems to be that science proceeds without moral obligations; it is neither moral nor immoral, but in essence amoral.

BUT in the applications and consequences of science, there is quite another story. No amount of complacency with things as they are can conceal the fact that science has enormous social implications, that it is continually transforming man's environment, and that while most of the transformations seem all to the good, others are exceedingly painful if not downright tragic. In other words, science keeps on assiduously transforming the world, and trusts to luck that the transformations will be benign, beneficial to the majority.


Hon. Henry A. Wallace

The customary rejoinder at this point is that research would never get done if the scientist endeavored to foresee the social consequences of his research, and that—which is more to the point—no human mind ever could foresee the consequences. Could Faraday and Maxwell, it will be asked, have foreseen the social problems—and opportunities—involved in the development of electric power? Of course they could not. Nor could Watt have visualized the full results of his work, or Galileo of his, or Mendel of his.

A rejoinder of this sort really only demolishes a man of straw. No sane person would ask or expect a scientist to foresee what cannot be foreseen. Nor would any thinking person insist that scientific research be limited to projects

Typical of the machine's easy conquest of obstacles. In replacing manpower, have such applications of science fulfilled a mission for the good of all?

the results of which we may be sure, in advance, will be socially comfortable and convenient. Indeed, any proposal to limit research is hardly intelligent.

But that is not the point. What we are concerned about today is not scientific research, *per se*, but the practical applications and the consequences of that research. Society can believe in science with an unshakable faith, can insist upon more and more research in every field, but society must at the same time be exceedingly watchful of the consequences of the layman's application of science to the social organization. And yet it is precisely at that point—the point of contact between science and society—that the orthodox scientist either withdraws to his cloister, to mutter about the stupidity of mankind, or, if given to public utterance, to indulge all too frequently in amazingly unscientific statements of a variety habitually used by the very politicians he scorns. I question whether that kind of activity is either an adequate defence of science or a contribution to our sorely perplexed society.

HERE, for instance, is a factory hand shoved out onto the bread-line because labor-saving machinery has been installed in his factory. In good times it may be months before he can find another job; in bad times, years. Science perfected that labor-saving machinery. Despite the fact that science at the same time has created new jobs, stimulated new wants, the interval between his old job and a new one is all too often a tragic interval for that wage earner and his family. What do you suppose is the reaction of that individual to statements that science does not, in fact, take away jobs? Or to the recent statement of a distinguished scientist that the "benefits of scientific research flow to all classes of the population and even the least competent of the people find themselves a step further from the starvation line"?

I marvel at the complacency of remarks like that in times like these. Virtually all scientists, I am sure, want the benefits of scientific research to flow to all classes of the population; to many scientists reveling in the luxury of indulging their intellectual curiosity, the thought that science is benefitting all men, even the least competent, is a comforting and a Christian reflection.

But I should want to be sure it was true. It is hardly enough to wave away the charge of technological unemployment with a few casual statistics about the abolition of the carriage industry and the subsequent sensational growth of the automobile industry. Certainly any such statistics should be examined and presented more carefully, more scientifically, if you please, than is done in the usual after-dinner speech before a group of well-fed scientists and donors of funds for research. Perhaps it might be a good idea, in order to encourage scientific caution, to have a few of the technologically unemployed present at such occasions to engage in some mild heckling.

Those who are interested in examining this problem of technological unemployment, and of the social implications of science, might consult that very useful report prepared during the previous Administration, "Recent Social Trends." The authors of this could hardly be accused of unfriendliness to science, yet they declared that the majority of American workers are chronically threatened either with total loss of income through unemployment, or with unpredictable fluctuations in the buying power of their income due to changes in the price level. In the last 15 years there have been three huge changes in the price level, and four cycles of unemployment. Technological unemployment seems to increase with increase in invention, and seasonal unemployment is growing due to the increasing violence of style changes. Regional shifts in industry, though not increasing total unemployment, make for great local hardships. Finally, although the proportion of older people in the total population is steadily gaining, the older workers, even those over 40, are finding it harder to keep their jobs. It would be possible to point to parallel problems in agriculture.

All this, plainly enough, is not the fault of science; it is a product of the misuse by society of the instruments and forces science has given to the world. But in that misuse, in that exploitation, all of us have some responsibility, and it seems to me that the scientist, for reasons of self-interest if for no other, ought to have a peculiarly acute interest.

LET me reiterate that I am not for a moment denying the contributions of science to society, or even arguing that there has not resulted a genuine net gain. What I do believe, however, is that we have reached the time when these gains may be lost altogether, and future gains made extremely difficult, unless certain social attitudes and adaptations are perfected very rapidly. And in developing these attitudes, in helping society to make the necessary adaptations, it seems to me that men of science must play an important part. They may not be able to foresee the consequences and the social implications of their researches, particularly in the field of pure science, but should they not have some voice in the use society makes of their research? Instead of complacent after-dinner speeches in sweeping defense of science, I should like to find our more articulate scientists insisting that the benefactions of science be used only in ways that are plainly in the general welfare. It would be encouraging to find, among scientists everywhere, some evidence of honest indignation at the way the gifts of science have been turned against society and therefore against science itself.

The scientist-in-the-cloister will, I suppose denounce all suggestions of this kind as scientific heresy. Perhaps they are scientific heresy—but our problem remains. The scientist does, it is true, face a dilemma inherent in his specialization. He is much inclined to let the shoemaker stick to his last; let the chemist, that is, stick to chemistry, the engineer to engineering, the mathematician to mathematics, the economist to economics—and the politician, presumably, to politics. But if extreme specialization is to prevail, no one should be surprised at the widening gaps between the chemist, say, and the economist, or

between the engineer and the politician. Nor should anyone be amazed that the chemist knows only chemistry, and the politician only politics.

The dilemma growing out of specialization is serious enough, I grant, but the real problem is elsewhere. The real problem is that so many scientific men still seem to hold that there are beliefs—notably economic and political beliefs—which are subject to acceptance, but never to inquiry. I have heard some of them talk as if the gold standard were an Act of God. No wonder it has been said that *laissez-faire* economics is closer to medieval scholasticism than almost any other intellectual activity in the modern world.

I suppose our scientists and inventors today have enough new stuff within their grasp or just around the corner so that the world 30 years hence could easily have a total productive power twice that of today. It is almost equally possible that the total wealth-producing power of the world a generation hence will be less than it is today. The trouble, if it comes, will not be in the inability of scientists and technologists to understand and to exploit nature, but in the ability of man to understand man and to call out the best that is in him. In solving this limitation the scientists and engineers have all too often been a handicap rather than a help. They have turned loose upon the world new productive power without regard to the social implications. One hundred years ago the power looms of England destroyed the cottage weaving industry, and during the early years of that impact misery strode over the countryside of England in proportion as the *nouveaux riches* gained capital to exploit their gains over the entire world. That kind of thing has been done again and again, and we have called it progress because the power of man over nature was increasing and because in the long run the common man shared in this increase. What happened to the common man in the short run, of course, could be of no concern to a *laissez-faire* society.

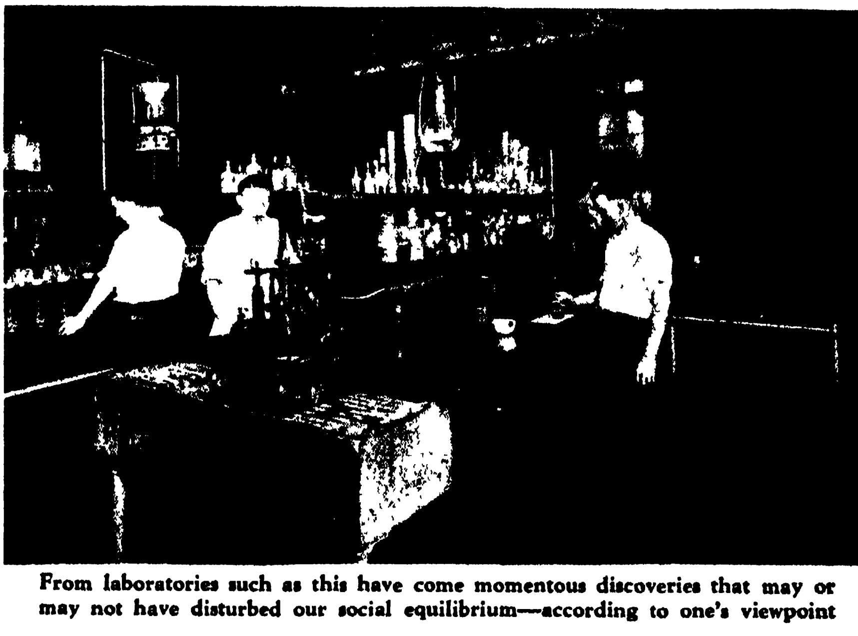
I WOULD like to suggest that the very training which made possible the enormous material expansion of the past century may to some extent have made impossible the building of a just social system for the prompter and more uniform distribution of the wealth produced by the system. Most of the scientists and engineers were trained in *laissez-faire*, classical economics, and in natural science based on the doctrine of the struggle for existence. They felt that competition was inherent in the very order of things, that "dog eat dog" was almost a divine command.

The power discovered by the scientists and inventors was applied in the United States by a race of men who had developed a concentrated individual willpower and an extraordinary thriftiness as a result of several generations of pioneer agricultural training and Protestant church-going. As a result, human power of high spiritual origin, but debased by the sophistication of the "devil take the hindmost" economics of the colleges, took command of the exploitation of the discoveries made by the scientists and inventors. The scientists and inventors have an intense kind of religion of their own—certain standards to which they like to be true—and as long as they could get enough money to pursue their researches, why should they care how someone else handled the social and economic power derived from these researches? Perhaps that is putting the matter unkindly, but other explanations that might be advanced are not much more flattering. Those who delved too deeply into social and economic problems got into trouble, and so many of the best scientists felt it was not good form to do things which to certain types of mentality seemed impractical and which might endanger science's financial support.

It is my observation that previous to 1933 more than three fourths of the engineers and scientists believed implicitly in the orthodox economic and social point of view. Even today I suspect that more than half of the engineers and scientists feel that the good old days will soon be back when a respectable engineer or scientist can be an orthodox stand-patter without having the slightest qualm of conscience. It is so nice to feel that there are great supermen from whom, directly and indirectly, we draw our own sustenance, who, sitting Jove-like above us lesser mortals, make possible the free functioning of the law of supply and demand in such a way that their profits enlarge at the same rate that our research expands. Like most of us, I rather like that kind of a world, because I grew up in it; in some ways, I wish we could get back to it. But both my mind and my instinct tell me that it is impossible for any length of time. Of course, if prosperity returns within the next year or two, it is possible for us to think that we are back in that old world again. But unless the people who make profits and direct capital allocation to different productive enterprises have seen a great light, or unless we move forward into certain highly centralized forms of industrial and governmental control, we shall sink back into our former trouble.

IT is difficult to see how the engineer and the scientist can much longer preserve a complete isolation from the economic and social world about them. A world motivated by economic individualism has repeatedly come to the edge of the abyss, and this last time possibly came within a hair's breadth of plunging over. Yet science, all this time, has been creating another world and another civilization that simply must be motivated by some conscious social purpose, if civilization is to endure. Science and engineering will destroy themselves and the civilization of which they are a part unless there is built up a consciousness which is as real and definite in meeting social problems as the engineer displays when he builds his bridge. The economist and the sociologist have not yet created this definite reality in their approach; can you who are trained in engineering and science help in giving this thought a definite body?

Secretary Wallace's challenge can not be ignored. We expect, therefore, to have comments on his article by a number of noted men. These comments will be published in coming issues.—The Editor.

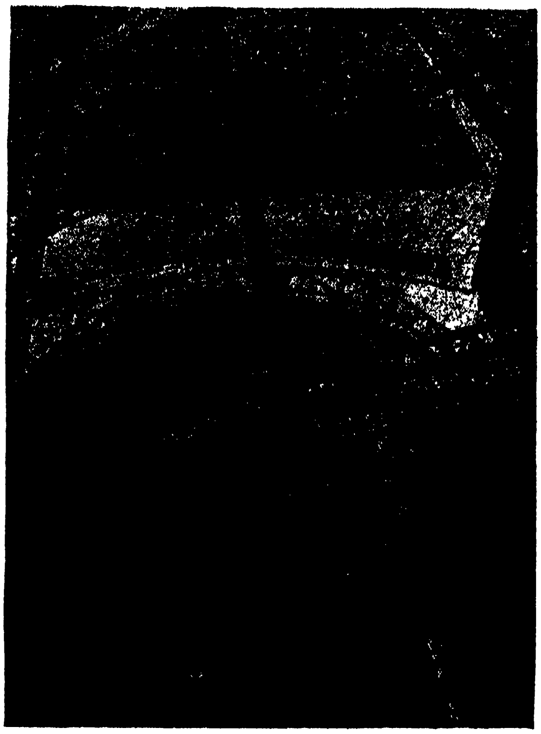


From laboratories such as this have come momentous discoveries that may or may not have disturbed our social equilibrium—according to one's viewpoint

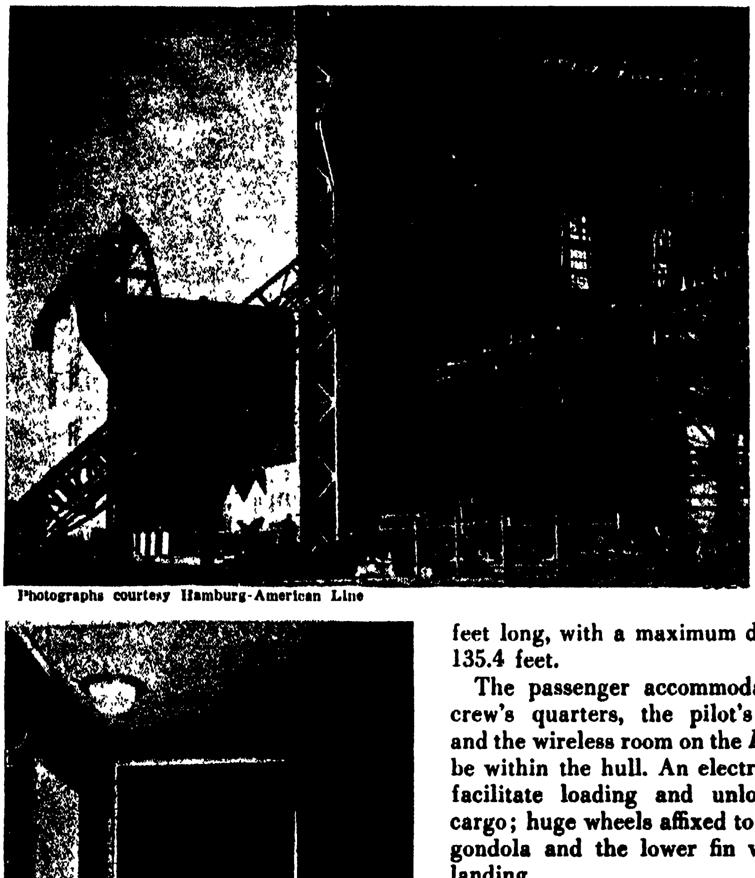
A FLYING HOTEL

Double the Size of the *Graf Zeppelin,* the *LZ 129* Will Provide Many Passenger Comforts

THE most ambitious aircraft yet designed for transatlantic service is rapidly nearing completion at the Zeppelin Works in Friedrichshafen, Germany. The *LZ 129,* big sister of the *Graf Zeppelin,* will have a volume of 7,070,000 cubic feet as compared with the *Graf Zeppelin's* 3,700,000. When completed next fall, the *LZ 129* will be 812.7 feet long, with a maximum diameter of 135.4 feet.

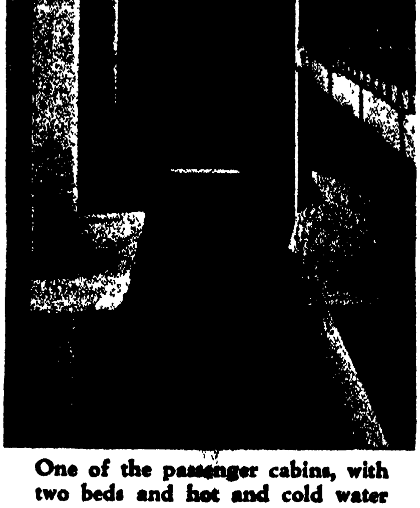


View from the unfinished skeleton of the *LZ 129,* showing one of the huge rings ready to be hoisted to its final position in the frame of the airship



Photographs courtesy Hamburg-American Line

Left: The ring starts up. A side view of the ring shown in photo above, partly clear of the ground



One of the passenger cabins, with two beds and hot and cold water

The passenger accommodations, the crew's quarters, the pilot's "bridge," and the wireless room on the *LZ 129* will be within the hull. An electric lift will facilitate loading and unloading the cargo; huge wheels affixed to the pilot's gondola and the lower fin will aid in landing.

The passenger accommodations will be on two decks with a total floor space of 5380 square feet. The upper deck will contain a dining-room, social hall, writing- and reading-room, and 25 passenger cabins, each with two beds and running hot and cold water. The used water will not be discharged, but will be conducted to a special tank as ballast. On either side there will be a 45-foot promenade deck. On the lower, or B deck, are to be baths, officer's and crew's quarters, and a smoking room. The *LZ 129* will be the first German airship on which smoking will be permissable. This has been made possible by the introduction as a lifting agent of helium gas, hitherto confined to United States airships.

After the frame work has been finished, the "suit" of the *LZ 129* will be tailored. The "pants" already have been completed, using a total of 35,000 square yards of cotton-linen material.

THE important choice of motors has been delayed to give the constructors an opportunity to await tests of the latest Diesel types. The *LZ 129* will be the first airship equipped for crude-oil locomotion.

The *LZ 129* will be able to travel 8000 miles without refueling, and will maintain a cruising speed of 80 miles per hour. She will accommodate 50 passengers and 10 tons of payload in addition to its crew of 35. The airship, if placed in the North Atlantic service, should be able to make the crossing in 40 to 42 hours eastbound and in 60 to 65 hours westbound.

The commission for designing the interior decorations of the new German airliner has been given to Professor Fritz August Breuhaus, of Berlin, who conceived the beautiful room decorations for the liner *Bremen.*—*By Wolfgang Lambrecht.*

OUR POINT OF VIEW

Cosmic Snoopers

WHAT is it that keeps a scientist at work? He has little or no hope of sharing the financial rewards he knows that others may reap from his discoveries. Commonly his devotion is believed to be the result of some kind of scorn for money. Few scientists, however, scorn money. Most of them would like to possess it, but they seldom have a chance even to consider the matter. The average scientist can find as many uses for money as the next man can. He, too, enjoys creature comforts, a widespread belief to the contrary notwithstanding.

Less commonly one hears that the mainspring which activates the scientist in his arduous research is his desire to benefit the human race. Sometimes this is true, and as an incidental it is probably always true, but it is not his main motive—not the one which holds him to his experiments.

What does hold the true man of science to his laboratory table is a much simpler thing: curiosity, pure curiosity. He wants to know "what it is all about." A woodchuck is curious to see what sort of erect-walking creature it was that chased him into his hole, and soon puts his nose out again, to look. Mrs. Jones is curious to know what is in that odd-shaped package which Mrs. Smith next door is bringing home, and puts her nose somewhere else to find out. The scientist is curious to know what is within the atom and beyond the galaxies and sticks his nose into all sorts of places in order if possible to learn more facts—not necessarily because he wants to use them but because he wants to know them.

Motivation such as this will not, of course, make the least sense to the kind of man whose every activity is pointed toward money alone. Another man, who is perhaps rather scornful of the money-making motive as an end-in-itself, may, however, fail to grasp the justification for a motive which has no end of any practical kind in view. But the motivation in pure science which is based on pure curiosity requires no justification whatever. It stands on its own hind legs. It is self-sufficient. We want to know new facts because we want to know them. We are in this universe—there is a lot of it both in variety and quantity—and we are plain curious to know all we can know about it. That end is what actuates the majority of scientists—the woodchuck-Mrs. Jones motive: Man finding his place in the universe he lives in. It is satisfying to know our surroundings and feel that we are oriented in them, both physically and intellectually. What better off shall we be when we are? When your argumentative friend asks you this, what can you answer? Well, if he is still that impervious, there is probably no hope. He isn't worth the trouble. Cut and run.

Impressions and Comparisons

THE Fleet's in!

To many people—and some moviegoers in particular—these three words will have a certain cheery meaning. However, to pacifists, proponents of adequate national defense, students of international affairs (also friendships and animosities), and those interested in the limitation of armaments question, they will have a variety of conflicting meanings.

When more than 100 vessels of the battle and scouting forces steam into New York Harbor on May 31, for the first large concentration of our naval units in these waters for a number of years, the sight will be most impressive and inspiring. Nevertheless, pacifists, reds, and malcontents in general will seize the opportunity to rave—but let's not steal their thunder; these are all vociferous and will create their own din. Quieter, and also saner, serious-minded, eastern observers will have the opportunity to study, for the first time in a large group in which it is possible to make comparisons, old and new, obsolete and modern vessels in different categories.

Steaming past the President in review will move majestically the great battleships, among which will be the *Mississippi,* recently modernized (as described in detail on page 298) so that it is now one of the most up-to-date ships of its class afloat. Our 33,000-ton aircraft carriers will be there (as may also be our new 13,500 tonner). Old cruisers and the newer line of 10,000 ton craft, destroyers (*all* old, for they are of war-time vintage!), submarines, the airship *Macon,* and certain tenders and auxiliaries will salute the President and proceed to their anchorages.

On that day, we in the east will voice excited pride in this display of the nation's finest. When they've anchored, however, and we have time to study these protectors of our interests, these defenders of the people's rights, it is to be feared that a conscientious shame will overcome us; we have been lax in our naval building for so many years that these vessels are too few and some too old to symbolize truly the might of a great nation. We shall then confess our fault in hazarding the lives of heroic men in inefficient ships, and promise to remedy the matter by writing our congressmen to appropriate the money for our new naval building program. It is not too late to build a Navy that will keep us out of other people's impending wars!

"One-Eyed" Drivers

SPEAKING, as we have frequently in the past, of safety on the highways, there is one point often mentioned which, while small in itself, is of vital importance to safe motor-car driving. We refer to the operation of a car, after dark, with only one headlight burning or without a tail-light. For such negligence there is no excuse. Many states have laws intended to reduce this dangerous practice, but it continues nevertheless.

Drivers who operate a car with improper lights should consider that they are endangering not only the lives and property of others but their own as well. When a car on a dark road has only one headlight burning, it is impossible for an approaching driver to guess which one is dark. He tries to play safe and often misjudges his distance and runs off the edge of the road. Or he errs in the other direction and there is a more or less serious collision. All for the want of a small electric light bulb and a little thought on the part of a driver.

Progress in manufacturing methods has produced bulbs that are far more efficient and sturdy than those of the early days of electric systems on motor cars. Present-day bulbs are also low in price, and cost certainly cannot be a factor in the number of "one-eyed" cars on the road today. The bulbs are small and spares are easily carried; in fact, some states require that such spares be in the car at all times. It is perfectly apparent to the alert driver when one of his bulbs burns out. Thus we arrive at the fact that the dangerous practice of driving without proper lights is a matter of gross negligence. Such cases should be reported to the proper authorities, and they in turn should make every effort to promote highway safety by enforcing the requirements for proper lighting of automobiles.

AIRMAIL

By REGINALD M. CLEVELAND

American Air Transport Operators Have Built Up the Finest System of Its Kind in the World. "They Can Do Even Better if They Do Not Have to Play With Loaded Dice."

AT this writing an air transport system which was at once the wonder and the envy of the world is disrupted and threatened with disintegration. The airline operators, synonymous, broadly speaking, with the airmail contractors, have been invited to bid on 17,000 miles of routes which are substantially two thirds of the same routes which they were flying under contract up to February 9 of this year. They have been invited to bid on these routes on temporary contracts of three months' duration with two possible extensions of three months each, pending the completion of new "permanent" airmail legislation by Congress.

The Postoffice Department which issues this invitation surrounds it with conditions which make it so difficult as to be well-nigh impossible for any of the experienced, properly equipped companies to bid. No company may bid which lost its contract under the decision of February 9, by which all the contracts were annulled on the ground that there were fraud and collusion in their making. No company, bidding under the new temporary set up, may have an officer who was present at the alleged collusive conference of May 1930. No company may bid which is in association as a subsidiary or collateral company with any which is in the business of manufacturing aircraft or aircraft engines or accessories.

At the same time, bids have been asked in 15 days and operations under them are to start in 30 days thereafter, or a total of 45 days in which to organize and equip a major airline. Manifestly no new companies can successfully bid under such conditions.

THE requirement for a minimum cruising speed of only 110 miles an hour in the proposals for bids by private carriers on temporary contracts may be said to set back the pace of aviation by about five years. It means that obsolete equipment can be pulled out of hangars and put in service on airlines that have come to know average speeds from 150 to 190 and more miles an hour. These same proposals also permit the use of varying plane equipment on the same long route; three changes, from multi-motored to single-motored and back to multi-motored types, being permissible on a transcontinental run. In these respects the Postoffice rulings merely make a bad matter worse.

Payments, under the temporary contracts, are to range from 41 to 45 cents an airplane mile. There are to be no additional payments for the very things which led primarily to the development of the superb system of air transport which now lies prostrate—radio equipment, night flying, and flying over especially difficult terrain.

It is small wonder that one of the major operators, Richard W. Robbins, president of Transcontinental and Western Air, Inc., the "Lindbergh Line," has characterized the whole succession of events since the day of cancellation as a "crazy quilt, with each new patch more ludicrous than the last."

A dense barrage of statements has been sent up from Washington after each "new patch." In them nearly all phases of aviation, commercial and military, have been involved. It would be difficult to imagine a more astonishing series of misstatements and wrong inferences than have been found in the public prints on this subject. In the turbid smoke thus created, the bare facts of the air transport system in this country, as it existed before cancellation of the airmail contracts, have been almost completely obscured. Some of these facts are as follows:

THE airmail lines were flying an average of 151,019 miles daily—including the American owned system of Pan American Airways which continues to operate—and flying 124,154 miles of this total with mail. They were serving 170 cities in the United States with airmail. They were doing it at a net cost to the government which did not exceed 7,000,000 dollars a year. This represents the difference between the amount paid by the Postoffice Department for the carriage of mails under contract and the amount received by the same department in airmail postage.

By building up their other sources of revenue—the passenger and air express business - the airlines had been able to progress in speed, safety, regularity of service and modernization of equipment despite a constantly diminishing return from airmail sources. The government had been able to secure a faster and more widespread system of mail delivery at a constantly diminishing cost per mile.

Thus, in 1929 Postoffice Department payments averaged $1.09 a mile; in 1930, 98 cents a mile; in 1931, 79 cents a mile; in 1932, 62 cents a mile; in 1933, 54 cents a mile, and the estimate for the fiscal year of 1934 was 38 cents a mile.

Great Britain, Sweden, and Holland had all paid us the very tangible compliment of sending experts to study our air transport system. It was admitted to be the best, as it was by far the most intensively used, system in the world.

This system had been built up under the so-called Watres act; "an act to aid civil aviation." Operating under this act, the then Postmaster General, Walter F. Brown, had gone about the business

of building up an integrated system of airlines and of stimulating the carriage of passengers and goods in the same plane which carried mails.

Postmaster General Brown had a definite and concrete aim in mind. He decided that there should be three transcontinental systems and two main coastal systems, one on the Atlantic seaboard and one on the Pacific. He wanted those lines in each case flown for their entire length by planes under single management.

For this he had definite reasons. He sought to avoid the pitfalls of the short-line railroad; the little line beginning somewhere and ending nowhere. In the aggregate, such lines have cost the American public untold millions of dollars; untold thousands of heartbreaks. Their bonded indebtedness has sucked up savings in an amount which makes the entire investment in American aviation look like a game of penny ante. Mr. Brown did not want to see this mistake repeated in the young industry of air transport. He wanted also to save the costs of multiple overheads and the inefficiencies of frequent changes of ownership and the use of many types of equipment along the same airway. He was seeking an articulated system which could function swiftly and well. The Watres act gave him the right to make contract awards to the "lowest responsible bidder." He put the emphasis on *responsible* and he got the kind of system he was looking for.

A study in contrasts. *Right:* An Army plane converted to mail work by removing the equipment from the rear cockpit and using this space for the mail bags. *Below:* A Northrup Alpha of TW-A, with a special mail compartment forward of the pilot's open cockpit

It is not contended here that every award under the Brown administration was a wise one. There were doubtless some "extensions"—perfectly legal under the act—which were political in character and not justified by the business in airmail obtainable on the line thus set up.

The Postoffice Department, egged on by the Black Committee, has charged collusion and fraud in the making of the contracts. No one will question the propriety of punishing every instance of collusion or fraud which can be shown. The airmail contractors have asked, indeed have demanded, their day in court to answer any such specific charges. Thus far it has been denied. Thus far the charges have been not specific but general. The operators stand all tarred with the same brush. The government has refused to consent to suit. They have been referred—one can imagine with how unctuous a tongue in the cheek—to the court of claims.

Ugly rumors, meanwhile, have had wide circulation as to short sales of aircraft stock in the days immediately prior to the cancellation of the airmail contracts. It would seem thoroughly worth while that these rumors be investigated, although it is a little idealistic to expect a Congress to pursue very ardently an investigation which might involve important personages in the majority party.

SUDDENLY, and as the tragic events proved, rashly, the Army Air Corps was ordered to fly the mails, on a limited schedule representing only a fraction of the daily service performed by the private lines. In characteristic Army style it took on the load and struggled gamely to carry the mail. In the first three weeks seven accidents cost ten lives of Army pilots, either flying the mail itself or making flights connected with its carrying.

Hotheaded supporters of the government policy rushed to point out that passenger plane crashes in the same period had cost more lives than the military ones. The period was marked by wretched flying weather; difficult alike for Army and civilian pilots. But the critics of the civil planes had forgotten the little matters of mileage flown and the number of accidents involved. The commercial losses came in two accidents; the military ones in seven. The civilian mileages for the period are not yet fully available but it is safe to say that they were at least four times those flown by the airmail service.

The Army was not to blame. The Air Corps fliers did not know the routes. They had been having an average of about four hours a month of flying as compared with 90 hours for the airmail pilots. The planes were not designed for mail load, carrying it, dangerously, back of the pilot in most cases, and the blind flying instrumentation, especially on the radio side, was not adequate because it was not intended for the purpose. But the tragedy remains.

Now the government would hasten to restore the mail to private contractors on a temporary basis and one which leaves them all—good and bad alike—under a like cloud of suspicion. They and the country have heard plenty of allegations of fraud and collusion. Now they want proof. If the transport operators can be assured of a real hearing, of an honest day in court; they will build anew. Last year they made a record of miles flown which compared with that of the next country in the world as 38 does to 4 or better than 9 to 1. They can do even better if they do not have to play with loaded dice.

RACE BETTERMENT BY

By J. H. LANDMAN, Ph.D., J.D., J.S.D.
The College of the City of New York
Author of "Human Sterilization"

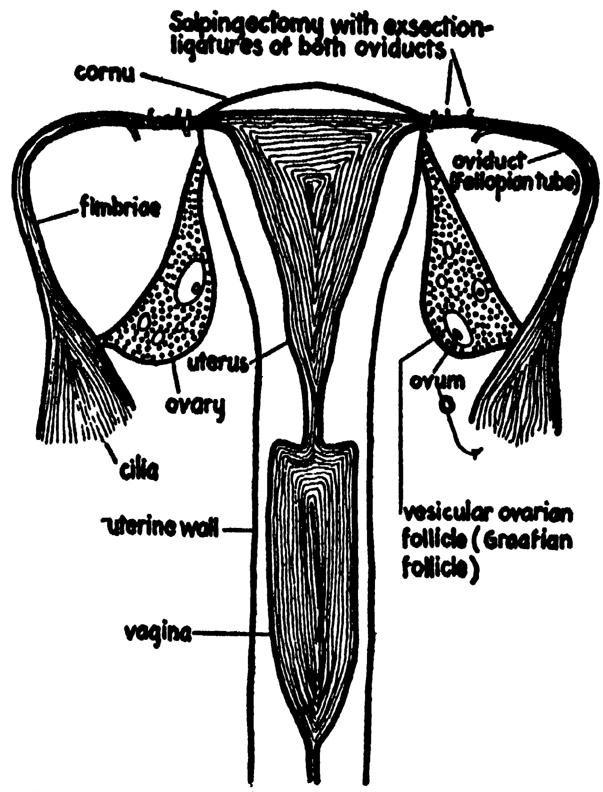
THE German human sterilization law which went into effect on January 2 of this year provides for the voluntary and compulsory eugenic sterilization of those Germans afflicted with one or another of such alleged hereditary diseases as hereditary feeblemindedness, schizophrenia, manic-depressive insanity, hereditary epilepsy, Huntington's chorea, hereditary blindness, hereditary deafness, serious hereditary bodily deformities, and alcoholism. According to semi-official reports emanating from Germany, 400,000 of these persons are to be sterilized with a view toward purifying the Nordic strain of the German people.

Of late, considerable discussion of eugenics and human sterilization has been evoked because of the scope of this law and the danger that it might be abused by subjecting the German Jews to sterilization not because of any hereditary malady of theirs but because of their race, though by all known scientific tests the Jews are a people of a high intelligence.

WHAT is human sterilization? Are castration and human sterilization alike? What effects has sterilization upon the individual, particularly on the sexual life? What people should be sterilized? What countries now practice compulsory human sterilization? What are their experiences with this type of legislation? These and many other questions come to mind as one cogitates about eugenic sterilization as a social therapeutic agency.

It is in the experiences of the United States with this legislation that one can find answers to these questions and it is in the United States that the question of population restriction and selection has been revived because of the chronic condition of unemployment in our midst.

Our country suffers to-day from an overproduction and an underconsumption of commodities, but also from a surplus reproduction of our population. As society is constituted at present, production, consumption, and population are not properly equated. Not that our country is too poor in natural resources and area to maintain its population. On the contrary, our country can support a still larger population. But one fifth of the population of the United States today is surplus—a mass of people that is socially unadjusted or maladjusted and that we can never altogether properly absorb into our social and economic life again. Many of these people are of such inferior quality that we should never want to incorporate them again



From Landman, "Human Sterilization," courtesy The Macmillan Company

Female sterilization consists of preventing the ovum from entering the uterus. This is called salpingectomy

into our society. These unfortunate people, many of whom are socially desirable and others socially undesirable, include the mentally diseased, such as the manics and the dementia praecoxes; the dependents, such as the unemployed, the deaf, the deformed, and the blind; the delinquents, such as the wayward and the criminals; the mentally deficient, such as the morons and the idiots; the degenerates, such as the sadists and the drug fiends; and the infectious, such as the tubercular and the syphilitics.

It is thus estimated that of the 125,000,000 people in the United States, over 25,000,000 are "misfit" or "unfit" and are unable to play properly their parts in society. The average number of patients in the hospitals of the United States in 1932 was 775,396. The total number of patients in the state hospitals for mental diseases at the end of 1930 was 323,688, a larger proportion than for any other group of institutions. The total number of patients in nervous and mental hospitals increased by 11,555 during the year 1930. The chance of anyone becoming insane, whether one be committed or not, is at least 1 in 10 at the present time. There were 64,253 feeble-minded and epileptics in state institutions in 1929. The state prisons had 116,670 inmates in 1930 and the federal prisons had 13,473 inmates in 1931. Between February 1 and September 30, 1932 as many as 207,694 arrests were made. Persons committed to prisons throughout the United States in 1931 numbered 70,966. The government is inclined to the opinion that there were about 100,000 narcotic drug addicts in the United States in 1932. According to the census of 1930, there were 63,489 blind and 57,084 deaf mutes in our country. Estimates vary but there must be about 10,000,000 unemployed in our country, 5,000,000 of whom will never again be absorbed in our present industrial life, according to President Franklin D. Roosevelt. It is no exaggeration then that there are 25,000,000 in the United States who are socially inadequate and who are a constant menace to our country and race.

Alarmist eugenists, such as Wiggam, Huntington, and Stoddard, have issued jeremiads with much eloquence, and sometimes with little evidence, of this impending self-destruction of humanity. They regard the dysgenic people as inimical to the human race. They believe that these people perpetuate their deficiencies and that we are bequeathing our civilization to the morons and the

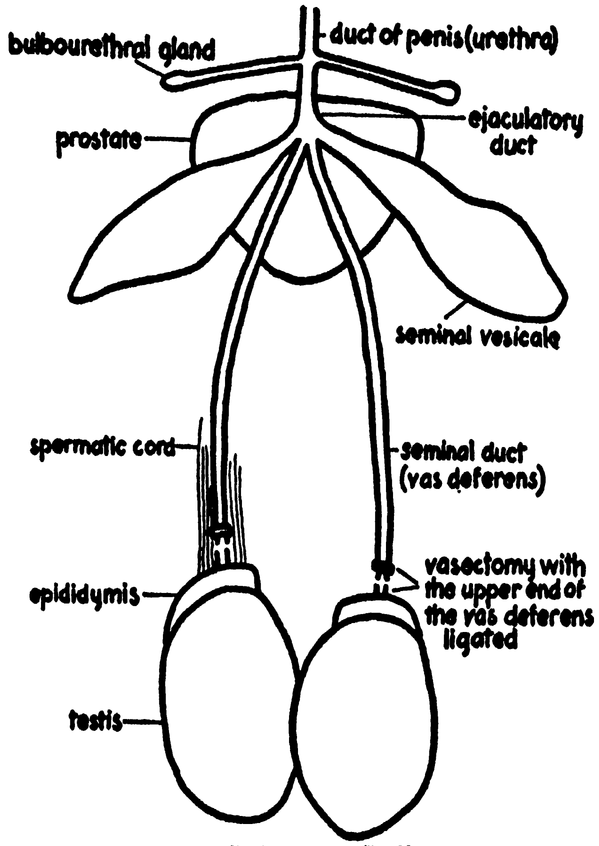
HUMAN STERILIZATION

idiots. They contend also that, regardless of the acquisition or inheritance of certain bad physical and mental traits, there are numbers of habitual criminals and defective delinquents who should be prevented from procreating because they are manifestly unfit for rearing citizens of our new generation.

The optimistic eugenists are much more hopeful. They contend that the socially inadequate people are not multiplying more rapidly now than in the past. They believe that the actual number of these unfortunates has not increased and that the statistical increase is only apparent, due to a more critical and better diagnosis of these unsocial people and to a more frequent institutionalization of them. They believe also that modern society needs these people to perform the less intellectual and the more automatic work of our mechanical age.

WHAT are the causes of this social pathology? Environmentalists and hereditists are divided as to the cause of this great social waste. Some social diagnosticians are more compromising and ascribe the evil to both environment and heredity. Sociologists with an economic leaning have accused the underconsumption, the overproduction, and the inequitable distribution of the wealth of our technological capitalism for our ever increasing army of unemployed and prescribe social planning, technocracy, or socialism. Among the many other environmental causes that might have contributed to the social inadequacy, bad associates, injuries at the time of birth, injuries to head during childhood, financial failure, disappointment in love, brain lesions, endocrine disorders and defective fetal development due to alcoholism, tuberculosis, syphilis, or malnutrition suggest themselves.

The hereditists, however, have been more convincing of late, primarily by exaggerating the scientific findings of eugenics. It is a young science and hence much that is myth, fable, or postulate passes for scientific fact. Our scant scientific eugenic knowledge has been prostituted to justify ancestor worship, race superiority, snobbery, class distinction, intellectual aristocracy, and race prejudice. What the science needs is more research and less propaganda. It is not true that boiler washers, engine hostlers, miners, janitors and garbage men, who have large families, are necessarily idiots and morons. It is not true that college graduates, people in



From Landman, "Human Sterilization," courtesy The Macmillan Company

Male sterilization consists of blocking the tubes from the testicles. This is not castration but vasectomy

"Who's Who," and some "successful" people, such as racketeers and bootleggers, are necessarily physically, mentally, and morally superior parents of our new generation. It is not true that celebrated individuals necessarily beget celebrated offspring. It is not true that idiotic individuals necessarily beget idiotic children. It is not true that the Jukes and the Kallikaks beget only criminal and idiotic children. It is not true that the Edwards family begets only superior children. It is not true that a mental trait, like high intelligence or idiocy, is transmissible in accordance with the Mendelian theory. It is not true that, because the color of guinea pigs is transmissible in accordance with the Mendelian theory, therefore human mental traits must also be transmissible in accordance with the Mendelian theory. It is not true that there are more children in the families in which both parents are idiots or feeble-minded than in which both parents are normal mentally. It is not true that, by any known scientific test, there is a Nordic race or that the so-called Nordic race is superior to any other race.

The belief that the population growth should be consciously controlled in the interests of all the people in the United States is widely entertained. This involves an effort to adjust numbers of people to the means available for their support, so that a high standard of living can be maintained. It means a development of methods of preventing the propagation of "the unfit" and in time, perhaps, methods of encouraging the propagation of "the fit" so as to improve the quality of the racial stock. Many find solace in the fact that our total national population has been increasing by lower decennial rates since 1860 and that the increase in numbers has fallen steadily and rapidly since 1923. Perhaps by 1950 our national population will become stationary and will even decrease after that date. But what of the socially unfortunates? Will they also decrease in numbers?

Among the several remedial measures, such as birth control, restrictive marriage laws, eugenic education, reorganization of our social and economic life, scientific breeding, painless peaceful death, *laissez-faire*, institutionalization, and others, alarmist eugenists advocate compulsory human sterilization. Their justification for this type of legislation is that many of these unsocial people have inherited their insufficiencies and are dysgenic, that is, potential parents of socially inadequate children, and the sterilization of them would necessarily prevent their propagation.

Twenty-seven states may legally practice human sterilization surgery in the United States to-day. Sixty-four different human sterilization laws have

been enacted since the legal inception of the movement in our country in Indiana in 1907. The first human sterilization act was introduced in 1897 in the Michigan legislature but it failed to be enacted. About 17,898 individuals have already been sterilized under the onus of this legislation. Many more individuals have been sterilized but these cases have not been recorded for fear of legal complications.

The United States is the pioneer in this movement and she is to-day the foremost champion and advocate of the cause in the world. In 1928 the province of Alberta in Canada, in 1929 Denmark, Finland, and the canton of Vaud in Switzerland, in 1932 the state of Vera Cruz in Mexico, and in 1933 Germany, espoused the cause. These foreign governments are the only other governments that have adopted this legislation. England, Norway, Sweden, and Western Australia are seriously considering adopting this social therapeutic agent at the present time.

The judicial history of human sterilization in the courts of the United States is interesting. Under the barrage of criticisms of religionists, humanitarians, and legalists, this legislation has run the gauntlet of the higher courts of the states. On eight different occasions, the respective state human sterilization laws were declared unconstitutional because they violated the Fourteenth Amendment to the Federal Constitution in that they denied "due process of law," and "equal protection of the laws" to all classes of people, and because the surgical operation was "a cruel and unusual punishment" and therefore constituted a violation of the state constitution.

IN ten instances the constitutionality of the acts was upheld. Especially has this been true since the eventful *Buck v. Bell* decision of May 2, 1927 in the United States Supreme Court. The court held unequivocally that the Virginia state law, authorizing the sterilization of mental defectives and others, under careful safeguards, is not void under the Fourteenth Amendment to the Federal Constitution since Carrie Buck was given an adequate trial and that she was not discriminated against arbitrarily as over against similar hereditary idiots at liberty. The early sterilization operations were usually castrations or the corresponding ovariotomies and hence the early court decisions declared them to be "cruel and unusual punishments" and therefore illegal. With the advent of vasectomy and salpingectomy, this legal difficulty is eliminated. Vasectomy is a simple minor operation which provides for the cutting and the ligating (tying off) of both sperm ducts, thus preventing the emission of the sperm. Salpingectomy is a similar operation except that both oviducts are cut and ligated, thus preventing the entrance of the ova into the womb. Surgeons have not been successful in making either operation reversible. Patients experience as little pain as if they had a tooth extracted and convalesce completely in several days. By virtue of this Federal Supreme Court decision, many new human sterilization laws were enacted.

The dependents, such as the unemployed, the deaf, the deformed, and the blind; the delinquents, such as the wayward and the criminals; the degenerates, such as the sadists and the drug fiends; and the infectious, such as the tuberculars, the syphilitics, and the lepers need not engage our attention. Most eugenists are in accord that their insufficiencies, *per se*, have been largely acquired or learned rather than inherited, and that these unfortunates should not be subject to coercive human sterilization. It is in regard to the two chronic and malignant groups of patients, that is, the mentally diseased, such as the maniacs and the dementia praecoxes, and the mentally deficient, such as the morons and the idiots, that there is considerable controversy concerning their causes. The question is still mooted. Its solution is fundamental to any constructive program for human sterilization. Yet most of the sterilization patients have been from these two categories.

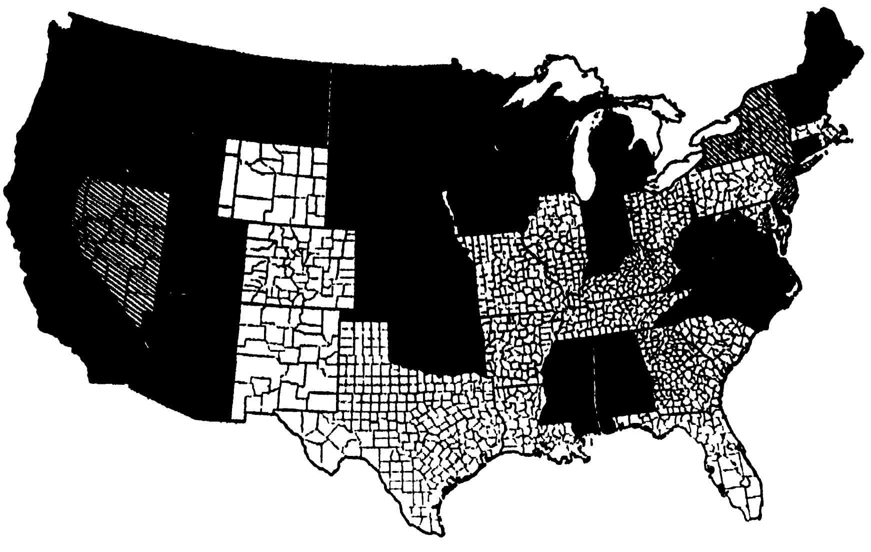
More eugenists are in agreement that psychoses or mental diseases are acquired rather than inherited but the preponderance of opinion is in favor of the theory that the mental deficiencies are inherited. Nevertheless, the answer to the problem of the hereditability of

STERILIZATION LAWS IN THE VARIOUS STATES

States	*Date of First Law*	*Citation of Law (b)*	*Citation of Adjudications*	*Nature of Decision*	*Number of Sterilizations to Jan 1, 1933*
Indiana	1907	Laws of 1907 Chapter 215	Williams v Smith (1921) 190 Ind 526	unconstitutional	385
California	1909	Statutes of 1909 Chapter 720			9,782
Connecticut	1909	Acts of 1909 Chapter 209			338
Washington	1909	Sess Laws 1909 Crim Code Sec 35	State v Feilen (1912) 70 Wash 65	constitutional	30
Iowa	1911	Acts of 1911 Chapter 129	Davis v Berry (1914) 216 Fed 413	unconstitutional	94
Nevada	1911 (a)	Rev Laws of 1911 Par 6293, Sec 28	Mickel v Heinrichs (1918) 262 Fed 688	unconstitutional	0
New Jersey	1911 (a)	Acts of 1911 Chapter 190	Smith v Board of Examiners of Feebleminded (1913) 85 N J L 46	unconstitutional	0
New York	1912 (a)	Laws of 1912 Vol II, Chap 445 Article 19	In re Thomson 169 N Y Supp 638 (1918) Osborn v. Thomson, (1918) 171 N Y Supp 1094	unconstitutional unconstitutional	200
Kansas	1913	Sess Laws 1913 Chapter 305	State v Schaffer (1928) 270 Pac. 604	constitutional	976
Michigan	1913	Acts of 1913 Act No 34	Haynes v Lapeer (1918) 201 Mich 138 Smith v Command (1925) 231 Mich 409 In re Salloum (1926) 236 Mich 478	unconstitutional constitutional constitutional	1,083
North Dakota	1913	Laws of 1913 Chapter 56			97
Wisconsin	1913	Sess Laws 1913 Chapter 693			492
Nebraska	1915	Laws of 1915 Chapter 237			451
New Hampshire	1917	Laws of 1917 Chapter 181			167
Oregon	1917	Laws of 1917 Chapter 279	Cline v Oregon State Bd of Eugenics (1921)	unconstitutional	882
South Dakota	1917	Laws of 1917 Chapter 236			139
Alabama	1919	Laws of 1919 Act No 704, Sec 10			131
North Carolina	1919 (a)	Laws of 1919 Chapter 281	Brewer v Valk (1933) 201 N Car 186	unconstitutional	46
Delaware	1923	Laws of 1923 Chapter 62			296
Montana	1923	Laws of 1923 Chapter 164			81
Virginia	1924	Laws of 1924 Chapter 394	Buck v Priddy (1925) Buck v Priddy (1925) 143 Va 210 Buck v Bell (1927) 47 Sup Ct. Rep 584	constitutional constitutional constitutional	1,333
Idaho	1925	Laws of 1925 Chapter 194	Board of Eugenics v Troutman (1931) 299 Pac 668	constitutional	13
Maine	1925	Laws of 1925 Chapter 208			41
Minnesota	1925	Laws of 1925 Chapter 154			693
Utah	1925	Laws of 1925 Chapter 82	Davis v Walton (1929) 276 Pac 921	constitutional	85
Mississippi	1928	Laws of 1928 Chapter 294			12
Arizona	1929	Acts of 1929 Chapter 44			20
West Virginia	1929	Acts of 1929 Chapter 4			1
Oklahoma	1931	Session Laws of 1931, Chapter 26, Art. 3	In re Main (Okla.), 19 P (2d) 153 (1933).	constitutional	0
Vermont	1931	Acts of 1931 No 174			30

(a) No statute now in force
(b) Legal data taken from *Human Sterilization* by J. H Landman. Appendix C

Total –17,898



STERILIZATION LEGISLATION IN THE UNITED STATES TODAY

the mental deficiencies is still conjectural. The psychotics or the mentally diseased have few children because they are comparatively short-lived, and they lack sexual attraction. The perniciousness of it all is that most of the psychotics are born of normal or apparently normal parents who are latent carriers of mental disease. Here too, the menace to society is not the obviously mental deficient but the individual who is a latent carrier of mental deficiency in his or her germ plasm. In recent years experimentalists, especially educationists, have been busily engaged trying to establish the relative importance of the rôles of nature and nurture in both low intelligence and high intelligence, but in vain. If anything, the controversy to-day is further from solution than it ever was, especially with the advent of the behavioristic psychology and its emphasis upon the environment as a factor in intelligence.

As for the therapeutic value of the human sterilization surgery of vasectomy or salpingectomy, the literature is meagre, cursory, and frequently prejudicial. The California studies would seem to lead to the conclusion that the sterilization surgeries of vasectomy or salpingectomy do not unsex the patients or noticeably change their sex lives, and improve their health. Other reports would lead to a contrary conclusion. In a California study, it was found that about one third of the married people who were sterilized were unhappy for various reasons. This proportion would have been perhaps larger among mentally normal people.

Of the various classes of socially inadequate people who are subject to the human sterilization legislation of the present, the feeble-minded, the idiots, the insane, the epileptics, and the imbeciles are most frequently included. It should be so since these classes of mental ailments display the greatest proof of inheritance, though perhaps not altogether conclusively. Yet other classes of people, such as prostitutes, convicts of at least two felonies, drug fiends, and sodomists are subject to compulsory sterilization, though, in accordance with the better scientific information, these people suffer from ailments that are acquired and may well be cured or arrested during their lifetimes. It might be mentioned that these classes of people are rarely included.

The execution of the various human sterilization laws reveals a glaring discrepancy between science and fact. In 15 states reporting, 6246 compulsory sterilization operations were performed on insane persons, 2938 on feeble-minded persons, 55 on persons suffering from epilepsy, 16 on criminals and 5 on those suffering from nervous disorders. About twice as many operations were performed on the insane as on the feeble-minded. Yet, all eugenists would agree that feeble-mindedness is much more hereditary than insanity and criminality. The number of operations on the feeble-minded should have exceeded that of the insane.

Only the statutes of California, Nebraska, South Dakota, Oklahoma, West Virginia, and Maine provide for the sterilization of inmates of institutions who are about to be paroled or discharged. All other sterilization acts make no such provision. Unless the sterilization operation has a therapeutic effect on the patient, there seems to be no justification for the operation. Its therapeutic value, as already indicated, is conjectural. Unless we can restore these sterilized people to society, why sterilize them? The eugenic justification for the sterilization of custodial inmates is not tenable.

What seems even more unreasonable is the fact that the sterilization acts apply primarily to mental patients in institutions when the alleged menace to society is the presence of these mental patients at large. Only Delaware, Iowa, Maine, Michigan, New Hampshire, North Carolina, Oregon, South Dakota, Vermont, and Indiana statutes provide for the sterilization of their selected dysgenics at large. Of course, it is, as a practical proposition, difficult to reach these people at liberty. Nevertheless, state agencies ought to be established in order to bring them into the pale of the law.

In several institutions for the insane in California, there were about 1000 institutionalized insane in the year 1927 suffering from dementia praecox and manic-depressiveness. After two years of institutionalization subsequent to the performance of the sterilizations, 67 percent of the males and 79 percent of the females, of those sterilized insane inmates who were studied, were still institutionalized. In a study of 605 case histories of the feeble-minded in the same state, 34 percent of the males and 28 percent of the females were still institutionalized. Advocates of human sterilization urge in behalf of the cause that it is not only an agency for race betterment but that its therapeutic value is so great that many of these people can be restored to society successfully and with impunity. These California studies are adduced to bear out this contention. Is the successful return to society of the feeble-minded patient due to the effects of the surgery or due to the conditioning, the vocational training and the psychotherapy the patient received in the institution? The results of Fernald, Mathews, Potter, McCollister, and Bernstein, with their psychotherapy, occupational therapy, medication, diet and the like, have been equally as good as those in California. Their patients are paroled or discharged whenever they show the proper emotional and mental constitution, which condition may really be the fundamental cause for the successful return of the sterilized or non-sterilized mental patients to society. The question of the eugenics of mental traits needs more research than speculation!

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A second article on human sterilization will follow next month, and a third, representing the opposing point of view, one or two months later.
—The Editor.

Fading Belief in

LIFE ON OTHER PLANETS

By HENRY NORRIS RUSSELL, Ph. D.
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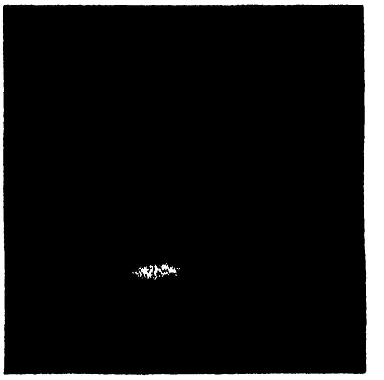
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

"THE earth's atmosphere is the astronomer's black beast." This literal translation from the French which the writer's old teacher, Prof. C. A. Young, used to quote with enjoyment is only too true. Half of the time (in our part of the country, at least) the atmosphere is cloudy. More than half of the rest it is so full of streaks and currents of uneven density that no fine detail can be seen through



A direct photograph of Mars taken at Lowell Observatory, by Slipher

it with the best of telescopes, and all of the time the ozone in its upper regions obscures the most interesting part of the spectra of the sun and the stars. It is by far the most active part of our planet, not only in bothering the astronomers but in more important ways.

The earth's atmosphere constitutes slightly less than a millionth part of the earth's whole mass and only 1/280 that of the ocean. But the rain which falls from it every century weighs seven times as much as the air itself. Three quarters of this falls back into the sea. Even so, the work of the weather amounts to pouring all the water in the oceans over the land once in every 12,000 years. Almost three quarters of this rainfall again evaporates. The rest runs back in the rivers, and the whole volume of the ocean has done this at least 30,000 times during the known duration of geologic history and washed down sediment enough to fill a quarter of the present ocean basins.

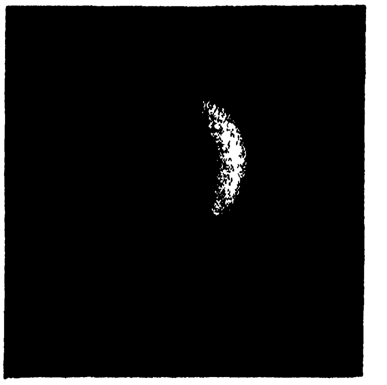
During this oft-repeated process the waters have dissolved from the rocks most, if not all, of the stuff which makes sea water salt and bitter. The atmosphere has been the vehicle of this enormous turnover. Has anything happened to it, too?

If the wearing away of rocks were accomplished by mere mechanical attrition the air would have nothing to do but to carry the water. But the greater part of rock weathering is a chemical process. The more easily attacked minerals are decomposed, leaving the resistant ones, such as quartz, to be pounded into sand. The principal reaction is the formation of soluble carbonates or bicarbonates of calcium, magnesium, and the alkali metals. These go down the rivers into the ocean, the sodium to stay and make the sea salt, the calcium and magnesium to be precipitated as limestone and dolomite (usually by organic action) and the potassium, strangely enough, to be adsorbed by mud and clay so that very little of it remains in the sea water.

ABOUT 8 percent, by weight, of the original eruptive rocks is dissolved in this way (according to Goldschmidt, from whose very interesting paper this account is taken). A great amount of carbon dioxide is consumed in the process. There is very little of it in the rocks—almost all must come out of the atmosphere. When the dissolved material enters the sea and the limestone and dolomite are formed, about one half of this carbon dioxide is liberated again. The rest is buried in the sedimentary rocks.

The amount which has thus been interred, according to Goldschmidt's calculations, is *15,000 times* as great as that which is now present in the atmosphere (forming but 1/2500 of the whole). There is 50 times as much dissolved in the sea as there is free in the air. The latter, if it could all be precipitated in the snowy form (dry ice), would make a layer less than a quarter of an inch thick. Without this saving remnant our planet would be a dead world. From the carbon dioxide of the air and with energy derived from sunlight, green plants, the most wonderful of all nature's laboratories, build up the complex compounds which form food for themselves and for all living things. The oxygen, which is the breath of life to an animal, is only a by-product of this fundamental process. There are so many living things on earth, and so little carbon dioxide in the air, that the whole of it must pass through some form of living matter every few years. Much of it, of course, is returned to the air very quickly, by the breathing of animals and the burning or decomposition of vegetable matter. A small part is locked up for centuries in such forms as wood and peat, and a still smaller amount of organic matter gets buried, turns gradually into coal or oil, and is lost to change for ages.

Except in the last case the oxygen liberated in photosynthesis is used up again in the various reverse processes, but the fossil organic matter is withdrawn from the cycle and must be balanced by a gradual accumulation of oxygen in the atmosphere. The suggestion that the present supply of oxygen has all been produced in this way is a century old. Recent studies confirm it, showing that the amount of fossil organic matter required to balance it amounts to only 1/2000 part by weight of the sedimentary rocks—a quite plausible amount.



Venus, photographed with 12-inch telescope, by H. A. Lower, amateur

Rock weathering, however, affects atmospheric oxygen as well as carbon

dioxide. Fresh eruptive rocks are usually darkish in color, grey or even black, owing to the presence of minerals containing iron in its less oxidized or ferrous state. During weathering these take on 50 percent more oxygen and turn to ferric compounds characteristically yellow or red in color. The yellow sands of the Sahara, the red rocks of the Painted Desert, and even the red clay of the ocean depth, owe their colors to the process of oxidation. Though slow, it is steady, and the loss of oxygen is irretrievable since, so far as we know, the change is scarcely ever reversed. Goldschmidt calculates that the total amount of "fossil" oxygen thus lost to the atmosphere must fully equal all that remains, and may be twice as great. This oxygen, too, must be balanced by organic matter in the rocks and, so far as the evidence goes, it well may be.

Rock weathering is still going on. If it continues at the present rate it might exhaust all the oxygen of the atmosphere in another billion years or so. Will life on earth end then? The fear is a bit remote, in any event, but it may be groundless. The enormous quantity of carbon dioxide now locked up in limestone must have gone through the atmosphere, but it could not have been all there at the start, for it amounts to seven times the present mass of the whole atmosphere—enough to raise the atmospheric pressure to 120 pounds per square inch. Some of it would have gone into the sea, but not enough to save the situation and make either sea or land habitable for such organisms as we know were there.

THE alternative is that the carbon dioxide has been added to the atmosphere bit by bit in the course of geologic time. Volcanoes emit enormous quantities of this gas, most of which doubtless comes out of the molten magma, deep down in the earth, and has never seen the light before. The average amount of this "juvenile" carbon dioxide which would have to be added each year to provide for all the limestone, is a hundred thousandth part of that which is now in the atmosphere, or 15,000,000 tons. The amount of the gas released yearly by the burning of coal and oil in human industry is more than 200 times as great!

In the long run, 90 percent of this carbon dioxide has gone into the limestones, 10 percent has been decomposed by plants into oxygen, and about a third of one percent remains free, mostly in the sea. The plants have so far kept well ahead of the red rocks—providing as much oxygen again as the rocks devoured. So long as the sun shines and the earth's volcanoes are active, the fear of a gradual suffocation of animal life may be laid aside. Should the worst come to the worst a race of no higher intelligence than present-day humanity could probably preserve its existence, though in diminished numbers; living, for example, in spacious glass-roofed enclosures supplied with artificially generated oxygen and growing its own food inside them if it would not grow elsewhere. The most severe demand upon their intelligence would be to take any steps at all to meet so very gradual a change in conditions.

Left: **A drawing of Mars made at Lowell Observatory through a 24-inch telescope and,** ***right,*** **a photograph of this same drawing made through the same telescope. Compare with direct photograph on opposite page. Why the vast discrepancy between drawing and photograph? The drawing is a composite of thousands of fleeting glimpses between times when atmosphere blurs visibility**

But what has all this—fact or fancy—to do with astronomy? Turn our spectroscopes on the nearest planets and we are answered. Adams and Dunham have found that Venus shows no trace of the familiar bands of oxygen or water vapor, even when her distance is changing most rapidly and lines produced in the planet's atmosphere would be shifted by the Doppler effect and brought to one side of the lines produced in our own atmosphere. But there are three beautiful bands in the deep red and infra-red which have been definitely traced to carbon dioxide. In the laboratory they are very weakly absorbed; to get them as strong as they are in the planet would require the equivalent of a layer of gas at least a quarter of a mile thick at standard temperature and pressure, which is fully 150 times as much as there is in the earth's atmosphere. This is the amount above the layer of clouds or haze which forms the planet's visible boundary. There may be much more below.

Such an atmosphere would exert a powerful "greenhouse" effect, letting the short waves of sunlight in and retarding the escape of the long waves from the warm surface. Wildt, one of the best men working on the subject, concludes that the temperature at the planet's surface may be as high as the boiling point of water. Life could hardly maintain itself under these conditions, and in its absence the carbon dioxide would remain in the atmosphere. Why there is no water vapor is a great puzzle—the surface must be bone dry. Wildt suggests that all the water has gone into some sort of chemical combination or hydration, but it is hard to see how this could happen if there had ever been anything like the amount that there is in our oceans.

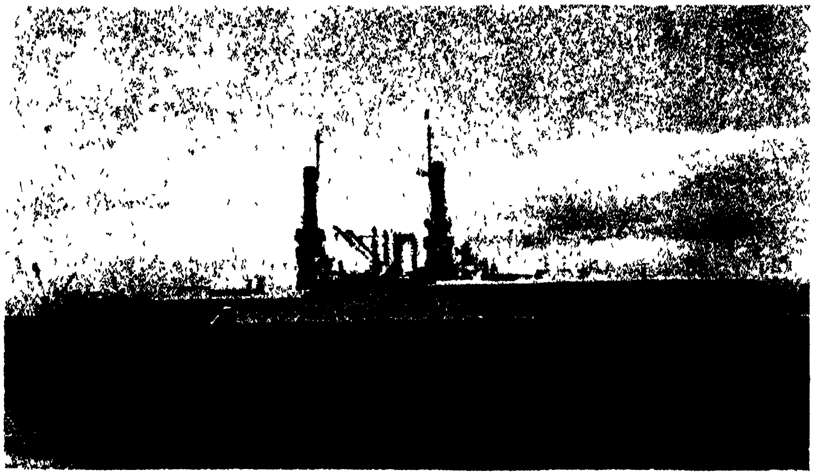
Mars, too, shows no traces of oxygen, water or carbon dioxide. The test for the last is insensitive and its failure does not mean much. That for water vapor is not delicate enough to refute the belief based on thermal evidence, that the polar caps are actually composed of snow evaporating below the freezing point under low pressure. But oxygen must be present in very small amounts, if at all—not more than a thousandth part as much as on earth. Whether there is any now or not, the red color of the planet's surface is very strong evidence that it was there once. Atmosphereless bodies like our moon show not a trace of red anywhere on their surface. The color of Mars is exactly that of an oxidized surface and there can be little doubt that ferric iron is actually to blame for it. May it not be that rock weathering has done its deadly work on Mars and depleted its atmosphere of oxygen? If the oxygen was of vegetable origin, there was once life on the planet. We cannot be too sure that it is not there still, for the exhaustion would be so slow that evolutionary processes might well be able to follow it, producing plants which conserve oxygen as terrestrial desert plants store up water.

IT seems, then, that Mars may represent a far later stage in the history of a planet than the earth, while Venus somewhat resembles the earth before life developed upon it—and we find ourselves, like the planet we live upon,

"Wandering between two worlds, one dead,
The other powerless to be born."

—*Princeton University Observatory*

MODERNIZING THE



The *Mississippi* as she was before modernization. The most noticeable feature, which she possessed in common with our other battleships, is the "basket-masts"

By W. D. PULESTON
Captain, U. S. N., Commanding the *Mississippi*

IT will be easy for city dwellers, particularly New Yorkers, accustomed to subway building, house-wrecking, and sky-scraper construction, to visualize the general problem confronting the naval engineers and constructors who modernized our battleships. Those who have seen civil engineers shore-up a many-storied building while they routed a subway tunnel through its former basement, can readily imagine the similar problems that confronted our naval constructors and engineers in shoring up decks with temporary stanchions while an additional superstructure was being installed. Yet it will probably surprise most city dwellers as well as country folk to learn that modernizing battleships was a familiar process to their sea-going European ancestors.

In the days of wooden ships, modernizing old men-of-war was the usual method of keeping a fleet up-to-date. In that era the cost of labor was low, but new construction was very expensive because of the cost of wood which was the only building material available to the shipwright. Furthermore, because of the poor roads, overland transportation of this bulky raw material was extremely costly, and as the forests near the European coast line were gradually depleted, the cost of masts and ship's timber forced impecunious kings, whose purses paid for the royal navies, to rebuild old vessels rather than to construct new ones.

The shipwrights' tools—the saw, the adze, and the axe—were equal to ripping into the wooden hulls, cutting out and replacing the rotted timbers and decayed knees. And with the adze the skilful ship's carpenter could scarf the ends of two timbers until they dovetailed neatly into one. The "tree-nails," large wooden pegs or nails, completed the union.

The reason for modernizing *our* battleships was not the dearth of building material, but the prohibition against constructing new battleships contained among the provisions of the Washington Conference of 1921-1922. This prohibition bore particularly hard on our Navy, because we scrapped ships under construction and nearing completion which embodied the lessons of the battle of Jutland, while we retained battleships dating back to the *Delaware* and *North Dakota*, our first dreadnoughts.

IN many ways, modernizing a battleship gave the constructor more difficult problems than new construction, just as building a subway under a city involves more intricate engineering problems than constructing a new railway. In fact the task of modernization would have been impracticable except for certain modern inventions and mechanical processes, notably those of "burning" and "welding."

The modern artisan has substituted his "burner" for the shipwright's saw. He burns off steel stanchions, bulkheads, and decks until he has laid a ship wide open for the rebuilding processes. The intense heat of his flame cuts through iron and steel more rapidly than the shipwright's saw could rip into the oaken timbers of the old ships-of-the-line.

But modern artisans use heat to rebuild as well, and they weld together the severed members they have so ruthlessly burned apart. Their uncanny ability to burn "together" or to burn "apart" would certainly have subjected them to trials for witchcraft had they plied their trades in Salem during the days when that city was fostering the infant shipbuilding industry in our country.

In modernizing the *Mississippi* it has been roughly estimated that an average of 50 welders were employed on the ship every working day for a period of two years. A very small portion of this welding was done by the acetylene process; much the largest part was done by arc-welding. Besides a host of minor items such as welding hooks, brackets, and small fittings throughout the ship, these welders made possible the installation of new bulkheads, plates, stanchions, and special foundations for guns and machinery.

PERHAPS the most interesting type of welding on the *Mississippi* was that done in welding the longitudinal and vertical seams of the "blisters." The reader will appreciate this task better if he is reminded of the necessity for and the origin of the blister.

Two formidable enemies of modern battleships are mines and torpedoes. Both of these attack the ship's underwater body where the battleship was formerly least protected and where a hole in the ship would cause the most serious consequences. Prior to the World War designers generally contented themselves with furnishing a ship with a double-bottom as protection against underwater damage. Since the battle of Jutland, designers have added the equivalent of a third bottom and in addition carried this new steel framework as a "void" or empty compartment up the sides of the ship from just above the keel to the armor shelf.

The theory of this new structure is that the mine or torpedo will explode outside and exhaust most of its destructive force in the new void before it

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The opinions and the facts in this article are the personal ones of the writer. They are not to be construed as official or reflecting the views of the Navy or the Navy Department.

U.S.S. 'Mississippi'

reaches a vital part of the ship. These new bottom and side voids were built within the outside skin of the ship in new construction such as in the latest British ships, the *Rodney* and *Hood.* The space available inside the old battleships being renovated did not permit the constructor to build interior voids, so in modernization the voids were built outside the skin of the ship and these bulges were promptly christened "blisters" by sailormen.

These blisters, which in appearance somewhat resembled pontoons with one side removed, were fabricated in the Navy Yard shops and secured to the ship's side by means of vertical angle-irons previously welded to the old skin of the ship. The *Mississippi* is 624 feet long, and as the blisters cover approximately three quarters of the ship, it is apparent that placing the blisters was an extensive operation.

THESE blisters were made in sections 15 to 20 feet long; they were required to fit neatly around the curving side of the ship. The necessary measurements were obtained from the ship itself by using large curved wooden patterns; these patterns were then used in the shop to cut the steel frames to the right sizes. Welding permitted a small leeway for errors, but these blisters when fabricated were exceedingly accurate and most of them fitted snugly.

Along the middle or "waist" of the ship, the inside frames of the blisters had approximately the same curvature, but as the blisters approached the bow and stern, the shapes of these inside frames changed rapidly in order to "fair up" the structure and preserve the "ship-shape" underwater body. This required close calculation by the designers and accurate workmanship in the shop. And the proof of the success is demonstrated by the fact that the maneuvering qualities of the modernized ship have not been reduced by the addition of the blisters.

After the blisters were fabricated in the shops they were loaded on flat cars and placed abreast the ship in dry dock. They were then swung into position by traveling cranes and connected to the outer hull by means of vertical angles previously welded to the skin of the ship. The plates of the blisters, forming the new bottom plating, were then welded where they abutted.

Arc welding with bare and covered rods was used to a great extent on new bulkheads throughout the ship, "T" welds being made where the plates met the deck or the overhead, and plain or "joggled" laps, welded on both sides, were formed vertically. In many cases, to facilitate or make possible access for various materials, passages were cut in bulkheads by acetylene torches and later closed by arc welding. The edges of the plating around such openings were beveled to about 45 degrees by chipping or grinding, and the "V" so formed was filled by welding.

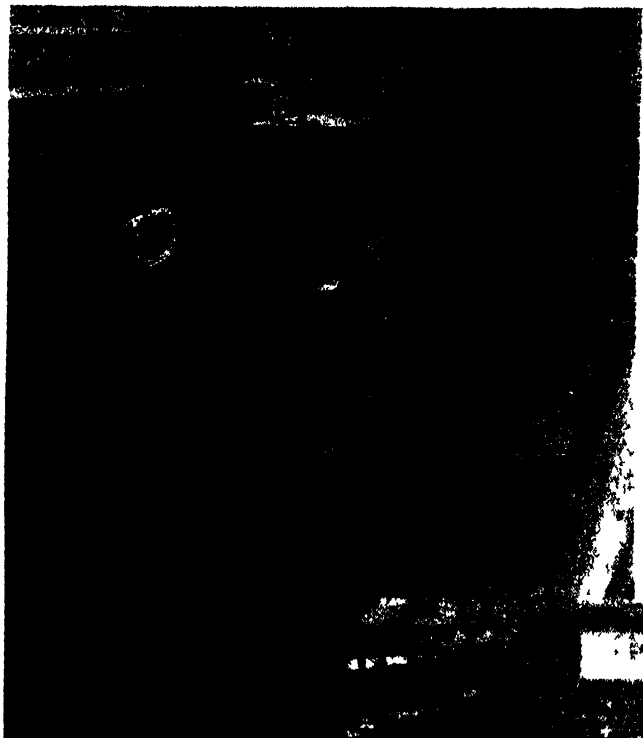
The first glance at the modernized *Mississippi* shows the final disappearance of masts from battleships and in their place structures resembling pagodas

During modernization, it was necessary to shorten a number of stanchions. This was accomplished by cutting a section out of the stanchion, butting the two parts and fillet-welding two curved straps (wrapper bands) over the joints. This process suggests the way sailormen "fish" a mast or spar. Space was left between the straps to make the vertical welds. While this method did not improve the appearance of the stanchions, there is no question of the strength of the joint or the economy of the operation.

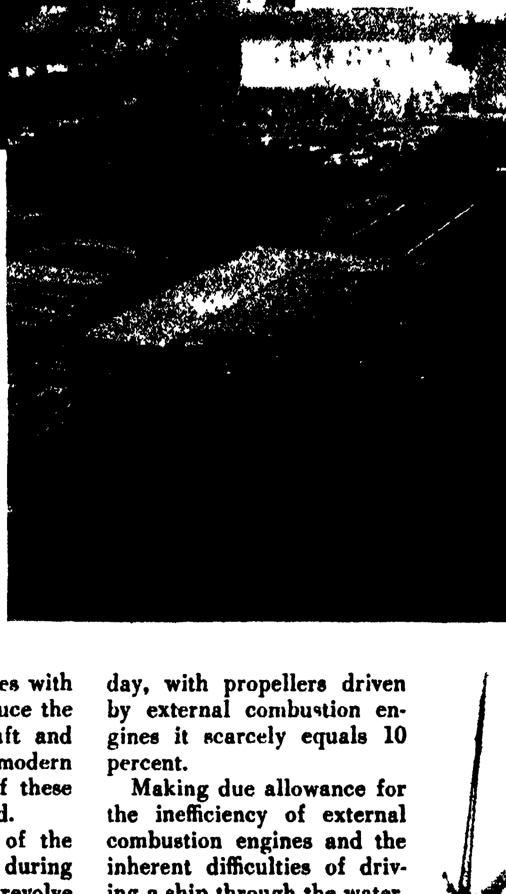
While the mine and torpedo were primarily responsible for the blisters, the improved seaplanes caused most of the other alterations effected during modernization. Most of us think of aviation only as the enemy of the battleship, yet every American battleship carries three to four planes. Without these planes, extreme battle ranges would be roughly 20,000 yards, because beyond that distance the fire of the guns could not be effectively controlled from the "fighting tops," and there is no advantage gained by shooting blindly in the general direction of the enemy.

Space inside any turret has always been scarce. When the additional elevation was obtained, it necessarily meant that the breech of the gun was correspondingly depressed, and this required more space. To meet this demand taxed the ingenuity of the ordnance designers. Yet they overcame this and other similar obstacles. Speaking in the most general terms, it was modern industrial development that enabled the designers to find the extra space. For example, a 50 horsepower motor of 1933 was much smaller than its 1917 ancestor. So by substituting the smaller for the older and larger electrical machines, and by skilful rearrangement of the interior of the turret, the extra space required by the new elevation was obtained without enlarging the exterior dimensions of the turret. When the proposal to elevate to 30 degrees was first made, the ordnance designers were doubtful whether that elevation could be obtained. During the modernization when the turret machinery was being installed, it frequently appeared to be a physical impossibility. But it was successfully done and now after completion the interiors of the turrets appear comparatively roomy.

ONE effect of modernization was to increase the displacement of the *Mississippi.* As the same general underwater body was preserved, this meant that increased horsepower was necessary; otherwise the speed was reduced. The Bureau of Engineering met this requirement by installing six new boilers which are really extremely fast steam generators. "Boiler" is a misnomer for a modern steam-producing



Attaching two shop-fabricated blister sections to the hull of a battleship. These sections must fit snugly all the varying underwater curves of the hull



Method of shop-assembly of all-welded blister sections for the *Mississippi*. View of the outside of two of the lower sections

apparatus that almost instantly converts water into steam. There isn't a vestige of the old method of raising steam by gradually boiling water remaining in this new type steam generator.

These boilers were designed by the Bureau of Engineering and built at the Norfolk Navy Yard. After construction they were taken down in three main parts and set up a second time on the foundations or "saddles" built into the ship.

To transform this steam into useful propulsive energy, the Westinghouse company furnished four of its marine turbines with the usual reduction-gears to reduce the revolutions required of the shaft and propellers. By using turbines of modern design, the sizes and weights of these four engines were much reduced.

The propellers and shafting of the four engines were unchanged during modernization and apparently revolve as readily for the new engines as they did for their former ones. The design of propellers has been given much study by design engineers. Naval architects and engineers are working continuously on the problem of ship-propulsion but there is surprisingly little improvement. In fact, with all the advances made in marine engineering and hull-design in the past 30 years, the co-efficient of propulsive efficiency of modern steamers is still low. In 1900, the ratio of useful propulsive energy to the total heat energy in the fuel consumed was between 7 and 8 percent. To-day, with propellers driven by external combustion engines it scarcely equals 10 percent.

Making due allowance for the inefficiency of external combustion engines and the inherent difficulties of driving a ship through the water, it does seem that greater efficiency should have been attained when we consider the progress that has been made in other fields of activity. Perhaps some readers of SCIENTIFIC AMERICAN will turn their minds to the problem of vessel-propulsion and effect some improvement! There is room for a great deal. But do not think the problem is an easy one and send in hastily-considered designs to already hard-worked designers. Devote some real thought to the matter.

Among the major improvements of the *Mississippi* during modernization was the installation of the most up-to-the-minute anti-aircraft battery.

In the decade following the World War, little money was spent on new ordnance or guns because the great war-making states were over-stocked with surplus guns. In consequence, there was little or no improvement in the design of anti-aircraft guns or fire-control apparatus. On the other hand, commercial as well as military aviation were daily increasing the speed, maneuverability, ceiling, and useful loads of planes. That is, all the elements necessary to the battle efficiency of the planes were being continuously improved, while the gun marked time.

BY 1925, the airplane was well ahead of its natural, and in 1918 its most formidable, enemy, the anti-aircraft gun. Finally, the danger to some of our great cities unless American anti-aircraft guns could be improved, brought some small but gradually increasing appropriations to the Army and Navy ordnance designers. Almost at once the effectiveness of gunfire against planes increased. Since 1925 there has been a continuous increase in the efficiency of anti-aircraft batteries comparable to the increase in efficiency of planes. And it is a conservative statement to say that the danger from enemy aircraft has been greatly reduced. Naval aviators naturally believe in their weapon, but the naval crews of the anti-aircraft batteries are no less confident of their ability to keep enemy aviators where they can do the ship no great harm.

Uncle Sam has always taken splendid care of his navy personnel, so when he

(*Please turn to page* 331)

One of the six new boilers for the *Mississippi*, which are really extremely fast steam generators

Objectives in Amateur Photography

The accompanying article, second in our new series on advanced amateur photography, outlines specifically what discussions you may expect in coming months. A few of our subjects follow:

- **Panchromatic flower photography**
- **Scenic pictures, including filters**
- **Stellar photography**
- **Infra-red and ultra-violet photography**
- **Amateur aerial photography**
- **Pinhole photography (less simple than it sounds)**
- **Portraiture**
- **Night photography**

SEVERAL years ago an amateur photographer—a sailor aboard the ill-fated steamship *Vestris*—was very fortunate. He happened to have his camera ready when that ship was sinking, and the views he was able to snap on the careening deck brought him a large sum of money as news photographs appearing in newspapers all over the land.

But we know a photographer even more fortunate. One day, after several less successful efforts, he managed to get an excellent "close-up" of a woodpecker at work 150 yards away by photographing through one glass of his binoculars. He received no sum of money for his success, and only his cronies, instead of the whole nation, saw his result. Yet this enthusiast, depending on no element of luck, had attained the priceless satisfaction of setting himself an interesting objective and reaching it, of mastering a novel technique. A priceless satisfaction—yet one within the range of any seeker.

WHAT pictures shall the "advanced amateur" photographer take after he has gone through his snapshot apprenticeship and wishes now to take his pleasure in this hobby more seriously? What are objectives that will "pay out" in the form of the greatest satisfaction?

Moreover, what is there in photography for the followers of other hobbies? Let the astronomers and the stamp collectors and the gardeners and the firearms fanciers examine the camera's prospects to see whether pictures, taken with benefit of their special knowledge, might not provide the "clincher" in the thorough pursuit of any avocation.

Informal portraiture is not necessarily the exclusive preserve of snapshotters. Especially now that snapshots indoors are possible, portraiture of family and friends in "natural" poses and normal settings takes on new meaning.

Carry the urge for pictures of people one step further, and the amateur photographer will find himself going in for formal portraits. Effects given vogue by the Hollywood cameramen will serve as par, and simple lightings will do the trick when basic principles are comprehended.

Action pictures, sports "shots," add the fascinating element of speed. To catch a hurdler at the top of his jump, with every determined line of his face recorded in focus, or to establish the graceful dip of a landing airplane in perfect composition on a negative—these, in the achievement, seem to give permanent meaning to transitory phenomena.

Nature photography is ground for serious study in itself. Flower photography, with the newly available panchromatic roll film rendering true color values, is almost unexplored. Toads and tadpoles may become what someone has called "backyard monsters" to the knowing lens of an alert hunter.

Artistic tendencies can find full play in scenic photography or still-life arrangement. Training the eye to discover striking compositions that can be enlarged from small areas of whole negatives, and enlarging them—there's a large part of the fun. Beyond that are adventures in the treatment of enlargements by such interesting embellishing processes as the bromoil transfer.

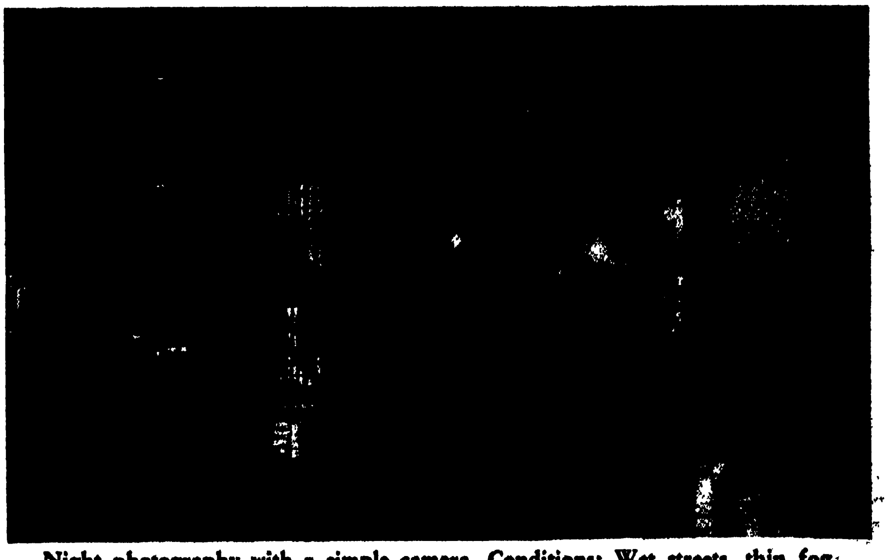
The problems of photomicrography have challenged experts, yet an amateur photographer can link his simple camera to a microscope and obtain successful pictures of that mysterious world half a dozen inches away. (Note page 304 of this issue.)

Astronomy! When the telescope has been made, glimpses through it remain only in memory, unless a camera is attached to it. Making a camera telescope is, thus, the logical next step for amateur astronomers. Even without a telescope, a simple camera with an *f*/4.5 lens is adequate for meteor photographs or pictures of star tracks. Add a prism, and there is always the lurking chance of catching a meteor spectrum that would be prized.

Amateur meteorologists can find their opportunity in photography of clouds, sun dogs, rainbows; and what about a superstereoscopic view of a cloud bank, made with two cameras a mile apart, snapped simultaneously to yield perspective in an old-fashioned stereoscope? There's gold—golden opportunity - overhead.

While we're about it, there is nothing to prevent amateur photographers from exploring the invisible with their cameras. Photographic materials sensitive to unseen phenomena in the ultra-violet and infra-red ranges of the spectrum are now available. Pictures in the dark, haze-penetration views, detection of stamp forgeries by photography of invisible color aberrations—these are "in the cards" for the curious.

Who knows but that someone fresh from picnic picturing with a "Brownie" may end up snapping the air waves left by a passing bullet? It's possible, and he would not even lose his "amateur standing."



Night photography with a simple camera. Conditions: Wet streets, thin fog, *f*/11 diaphragm setting, seven minutes exposure on Verichrome film

NITROGEN FIXATION and the Future

By CHAPLIN TYLER
E. I. du Pont de Nemours and Company

THIRTY years ago, in 1903, the inorganic nitrogen production of the world was 349,000 metric tons, 63 percent of which was supplied by Chile. In 1933, despite sub-normal consumption generally, the inorganic nitrogen production of the world was nearly five times as much, or 1,700,000 metric tons, less than 10 percent of which was supplied by Chile. Furthermore, world capacity for the production of inorganic nitrogen has been built up to an estimated total of 3,383,000 metric tons, or about double the present rate of actual production and consumption.

In 1905 the Norwegians started the first commercially successful nitrogen manufacture; that is, fixation as nitric acid by the arc process. This process, now obsolete, did however attain a peak production of about 30,000 metric tons of nitrogen per year, despite the large power requirement of 60,000 to 70,000 kilowatt-hours per ton.

SOON afterward, in 1907-08, the cyanamid process was operated commercially and grew in importance until a capacity of 350,000 metric tons of nitrogen was attained. This process, while successful commercially for a long period, requires from 10,000 to 16,000 kilowatt-hours per ton of nitrogen, and the product is not entirely satisfactory as a fertilizer.

Not until 1913, when the Germans began nitrogen fixation by the Haber-Bosch ammonia synthesis, did there appear a real threat to Chilean supremacy. In the short space of 20 years, fixation by the ammonia synthesis has grown to the proportions of an industrial giant representing an investment of 600,000,000 dollars, involving 110 companies operating 123 plants in 19 countries.

The major economic consequences of this development have been: First, the destruction of the Chilean monopoly in nitrogen and the decline of the Chilean industry; second, the worldwide sufficiency of cheap nitrogen for agriculture; third, national independence of practically every important world power as to nitrogen supply for war munitions; and fourth, the application of the new high-pressure catalytic technique to the synthesis of methanol and the hydrogenation of numerous substances, especially of coal and oil, for the manufacture of synthetic motor fuel.

The former position of the Chilean nitrate industry is not easily appreciated without recourse to figures. Approximately 70,000,000 tons of nitrate (16 percent nitrogen) have been produced, which at 40 dollars per ton in Chile represents a total realization of 2,800,000,000 dollars. The former normal production of 2,500,000 metric tons of nitrate (16 percent nitrogen) per year represented an export trade of more than 100,000,000 dollars on which the national export tax was about 30,000,000 dollars per year, of which American consumers alone paid about 10,000,000 dollars per year.

Synthetic ammonia (fixed nitrogen) works of the du Pont company at Belle (Charlestown), West Va.

To ship this quantity of nitrate required between 400 and 500 cargoes per year, assuming a lading of between 5000 and 6000 tons. The ocean freight on this movement was from 12 to 15,000,000 dollars per year. In the future, the volume of shipments is unlikely to exceed half of the former average of 2,500,000 metric tons, and the price in Chile may not exceed half of the 1926 price; therefore the realization of the industry, instead of being around 100,000,000 dollars per year, may not exceed 30,000,000 dollars.

While tremendous effort has been made in the past five years to retain for Chile a continued commanding position in the nitrogen industry, it now appears that this effort was begun at least five years too late, that it was not too well conceived, and that finally, the potentialities of the synthetic ammonia development were grossly underestimated.

Year after year, nitrate to the value of 100,000,000 dollars was produced and yet the synthetic ammonia industry was well established before any vigorous action was taken regarding improved processes and drastically lowered prices. It has been estimated that the Chilean industry, which so easily could have set up ample reserves for development out of earnings, now is in debt to the extent of 275,000,000 dollars, a sum about ten times the present annual sales.

So complete has been the change in affairs that during the period 1932-33 the exports of synthetic nitrate of soda from the United States were about double the imports of Chilean nitrate. Norway also has a large balance of exportable synthetic nitrate of soda.

NORMALLY, the depletion of soils is a serious problem. The plant food in the soil is the most fundamental wealth of civilized peoples. Such crops as cotton, tobacco, and potatoes remove enormous quantities of "money" from the soil "bank account." Nitrogen, now derived largely from synthetic ammonia, is the most easily depleted plant food. Therefore it must be replaced, else agriculture eventually must be moved to virgin soil, of which there is none too much in the densely populated areas of the world.

The continual addition of nitrogen, together with other plant foods, enables the farmer to harvest a never-ending succession of crops from the same soil. Synthetic ammonia therefore is the chemist's insurance to the people that there never need be an insufficiency of not only cereal foods, but of protein foods as well, since milk, beef, and pork, for example, are produced from cereals and grasses.

Part of the nitrogen taken from the soil by crops is returned as natural manures, as nitric acid in rain water, and by the action of nitrogen-fixing bacteria. But this natural return of nitrogen is insufficient to maintain a correct balance in the soil, so that normally a supplemental quantity of from 300,000 to 400,000 tons of "artificial" nitrogen is used annually in this country in the form of commercial fertilizer. The total consumption for the world is about five times this quantity.

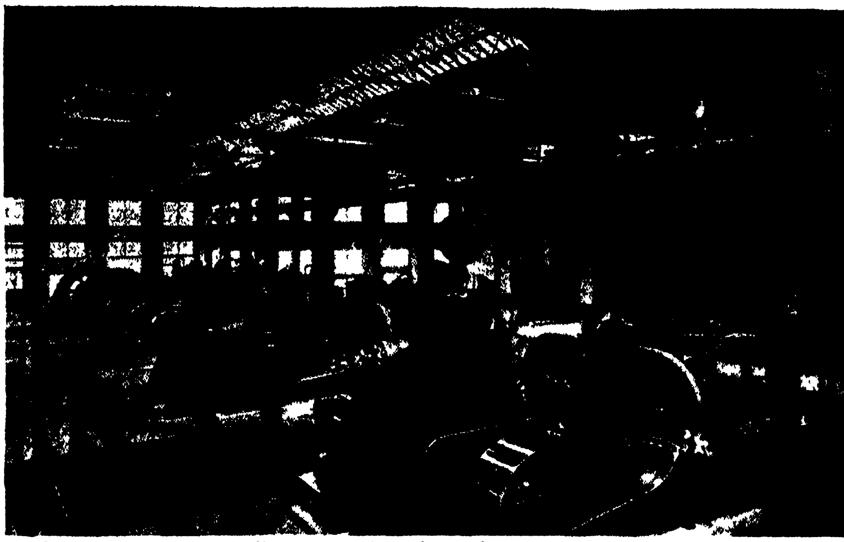
As stated previously, a large part of fertilizer nitrogen formerly came from Chile as the well-known "Chile saltpeter." While Chile saltpeter or nitrate of soda is an excellent fertilizer material, it was until the advent of the synthetic ammonia industry a comparatively expensive commodity. Whereas in the past nitrogen has been relatively expensive, today the cost of nitrogen actually is substantially as low as that of phosforus and not much more expensive than potash.

WITHOUT nitrogen, a major power hardly could start a war, much less sustain one. Ammonia, as such or converted to nitric acid, is an essential ingredient of modern military explosives. Similarly, without nitrogen, a power would be defenseless against outside aggression. Nitrogen ranks with steel, food, and clothing as a sinew of war.

The War Department has estimated that in the event of a major conflict the United States forces would require for munitions production 144,000 tons of nitrogen per year. This is equivalent to 900,000 tons of Chilean nitrate of soda, or 150 cargoes carried in the ordinary freighter of 6000 tons capacity.

During the World War, the fear of insufficient supplies of nitrogen was so great that the Congress appropriated 80,000,000 dollars of the taxpayers' money to build the much-publicized Muscle Shoals nitrogen plants, which incidentally could have turned out but a third of the nitrogen needed for munitions alone. Today it is of interest to note that the Belle, West Virginia, works of the du Pont company alone is sufficient to supply the entire requirements of the War Department in time of emergency.

Another large plant, that of the Allied Chemical and Dye Corporation at Hopewell, Virginia, produces synthetic nitrate of soda and ammonia, thus affording double security for nitrogen supply in case of need. The investment in these two plants, plus that of smaller producers of synthetic ammonia, is estimated to be between 80 and 90 million dollars, or about the same as for the Muscle Shoals plants. The capacity, however, is more than six times as great, assuming that Muscle Shoals could be operated at capacity.



Gas compressor installation in the plant shown opposite. Here synthesis gas is compressed to 15,000 pounds per square inch—one third as dense as water

The development of high-pressure technique by the synthetic ammonia industry has led to other operations of far-reaching significance. For example, about ten years after the first factory production of synthetic ammonia, Germany exported to this country synthetic methanol, made by the same general technique.

Today the wood distillation industry, which formerly produced about 7,000,000 gallons of methanol per year, produces only about 1,500,000 gallons per year, whereas about 8,000,000 gallons are being produced by high-pressure synthesis. The synthetic product is cheaper, more pure, and is practically limitless as to supply.

Another high-pressure synthesis, and one which may easily surpass the tonnage of ammonia itself, is that of coal and oil hydrogenation. Both England and Germany, which are large consumers of motor fuel and yet which have no petroleum resources, are developing the production of synthetic gasoline on a very large scale. This process is more than likely to prove profitable, and again serves to illustrate the rôle of chemistry in making nations more self-contained as to supplies of essential commodities.

Other applications of high-pressure technique are being evolved and will no doubt have added effect upon existing processes and upon the balance of international trade.

World consumption of inorganic nitrogen probably will continue to increase at a rate of 50,000 metric tons per year—that is, the rate of increase which has held for the 25-year period from 1908 to 1933. Only in eight out of these 25 years has the world production of nitrogen deviated more than five percent from this straight-line growth.

THIS slow, but seemingly sure, increased consumption of nitrogen indicates that the present enormous excess capacity theoretically will remain for many years. Actually, the production costs attained in plants built within the past five years are sufficiently low so that a large proportion of the Chilean industry and of the cyanamid industry, together with many of the smaller or older synthetic ammonia plants, can be considered to be uneconomic. The indications are that the rate of earnings on capital in the nitrogen industry will be low; that is, nearer five percent than ten percent.

While agriculture theoretically should consume enormous quantities of nitrogen, the fact remains that the rich soils of our plains will sustain a nominal rate of production of grains for years to come without the aid of commercial fertilizer. Only on intensively cultivated areas is fertilizer a necessity, and the larger proportion of the 400,000,000 acres of crop lands is not so cultivated.

Therefore, while the outlook with respect to nitrogen fertilizer consumption is not unattractive, the time when an enormous quantity must be used is perhaps 100 years hence, rather than ten years hence. Beyond that era, should the area of cultivated land begin to be inadequate, it is perhaps comforting to know that protein foods, palatable and highly nutritious, can be made easily and reasonably cheaply from yeast plants fed in turn with nitrogen from synthetic ammonia.

THE AMATEUR AND HIS MICROSCOPE—XI

PHOTOGRAPHING SPECIMENS

By JOHN V. BUTTERFIELD

and

JOHN F. BRANDT

Bausch & Lomb Optical Company

THE great explorer fights his way through strange lands, taking pictures as he goes. Back home again he goes on a lecture tour, showing his pictures on the screen—strange people, ferocious beasts, weird sights that thrill his audience and for the moment take them with him through all his adventures. But no explorer who ever roamed can show you more fascinating pictures than you can take through your own microscope—pictures of specimens gathered within a stone's throw of your front door.

Photomicrography, like many other things, can be simple or complex. An expert photomicrographer will sometimes spend hours arranging the illumination of a single specimen. His apparatus is large and apparently filled with all sorts of gadgets until it looks like one of Rube Goldberg's famous inventions. His subjects are as difficult as his technique. But the specimens in which most of us are mainly interested can be photographed with a minimum of equipment and just enough difficulty to make it a lot of fun.

A photomicrographic set-up consists simply of a light source, a microscope, and a camera. The light source need be nothing more than an ordinary frosted Mazda bulb. A 50-watt size or larger will do. Any good microscope will suffice, provided it is equipped at least with a concave mirror or, better still, a substage condenser and plane mirror. Any camera may be used, folding or box. Its lens is not necessary. In fact a lens, unless it is particularly good, will detract from the quality of your pictures.

If the lens cannot be removed, focus the camera at the "infinity" or 100-foot mark. In other words, a light-tight box, with some form of film holder at one end and a hole for the microscope eyepiece at the other end, is all that is really necessary. A ground glass, or some other means of focusing in the same plane as the film, should be arranged.

The illumination necessary to produce good photomicrographs is much more critical than that which is generally used for visual work. In the first place, the illumination must be brighter, and it must be carefully focused on the specimen. The photographic emulsion is capable of showing variations and errors in illumination much more readily than the eye and improper illumination may lead to erroneous interpretation of details in the specimen.

A simple type of professional photomicrographic equipment. The observation eyepiece permits the user to see the specimen till it is photographed

A "good" microscope was mentioned above, since there is no more extreme test of the quality of an instrument than making photomicrographs. In this work the resolution becomes all-important, and the lack of flatness of field which might be overlooked by the eye is only further emphasized by the photographic negative. I do not mean to say that only an expensive microscope will give you these qualities to an adequate degree, but price is invariably the measure of the quality of a microscope. The microscope should be fitted with either a concave mirror or a substage condenser of the correct focal length, and a plane mirror to bring the light to a focus on the specimen. The microscope may be used in either a vertical or horizontal position.

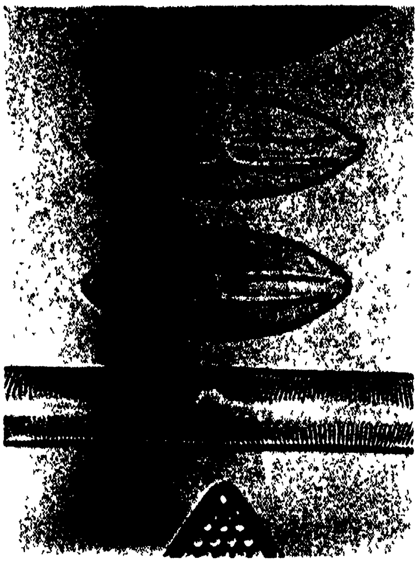
The only further requirement for the camera, other than that already mentioned, is that it be mounted rigidly in line with the microscope optical system and that the negative be exactly parallel with the specimen. A light-tight connection between the camera and the microscope eyepiece may be arranged in several ways. One of the simplest is to wrap a piece of black cloth, such as velvet, around the top of the microscope eyepiece and press it against the camera around the opening. A shutter is convenient, but not an absolute necessity. The exposure time may be controlled by simply switching on and off the illuminating source for the required amount of time.

THE complete photomicrographic set-up should in some way be protected from vibration. Several pieces of felt may be used, or a sponge rubber kneeling pad may be bought at the ten-cent store and placed under the whole arrangement when it is mounted on a wooden or metal frame. Of course, complete photomicrographic outfits can be bought. You may be satisfied with the arrangement as suggested above, or it may serve merely to give you an idea of how fascinating this part of your hobby can be before you purchase the regular equipment.

The amateur is not generally acquainted with the theories of image formation and resolution. It is not necessary to know all of this in order to obtain good photographic reproduction, but it is necessary, however, to know the conditions which must be set up in the system, which will fulfill the requirements of the theories. Most important of all is the proper illumination of the specimen. Making clear pictures with sharp detail is entirely dependent on illumination.

For maximum resolution of detail in specimens, and an even brightness over the entire field of view, the following

conditions must be met: (1) When the specimen slide is on the stage of the microscope the specimen should be at the apex of the cone of light focused by the concave mirror or the substage condenser. (2) The cone of light from the mirror or substage condenser must form an image of the source of light in the plane of the specimen. (3) Observation of the beam of light emerging from the eyepiece at the point called the "exit pupil," Ramsden disk or eyepoint, or the back lens of the objective as seen through a pinhole placed over the eyepiece tube of the microscope when the eyepiece has been removed, must show a full, evenly illuminated disk of light. (4) From condition 2 it follows that the source of light must be of such a size that the image, which is formed by the substage condenser or mirror, will be large enough to cover the area of the specimen which is being projected through the microscope.

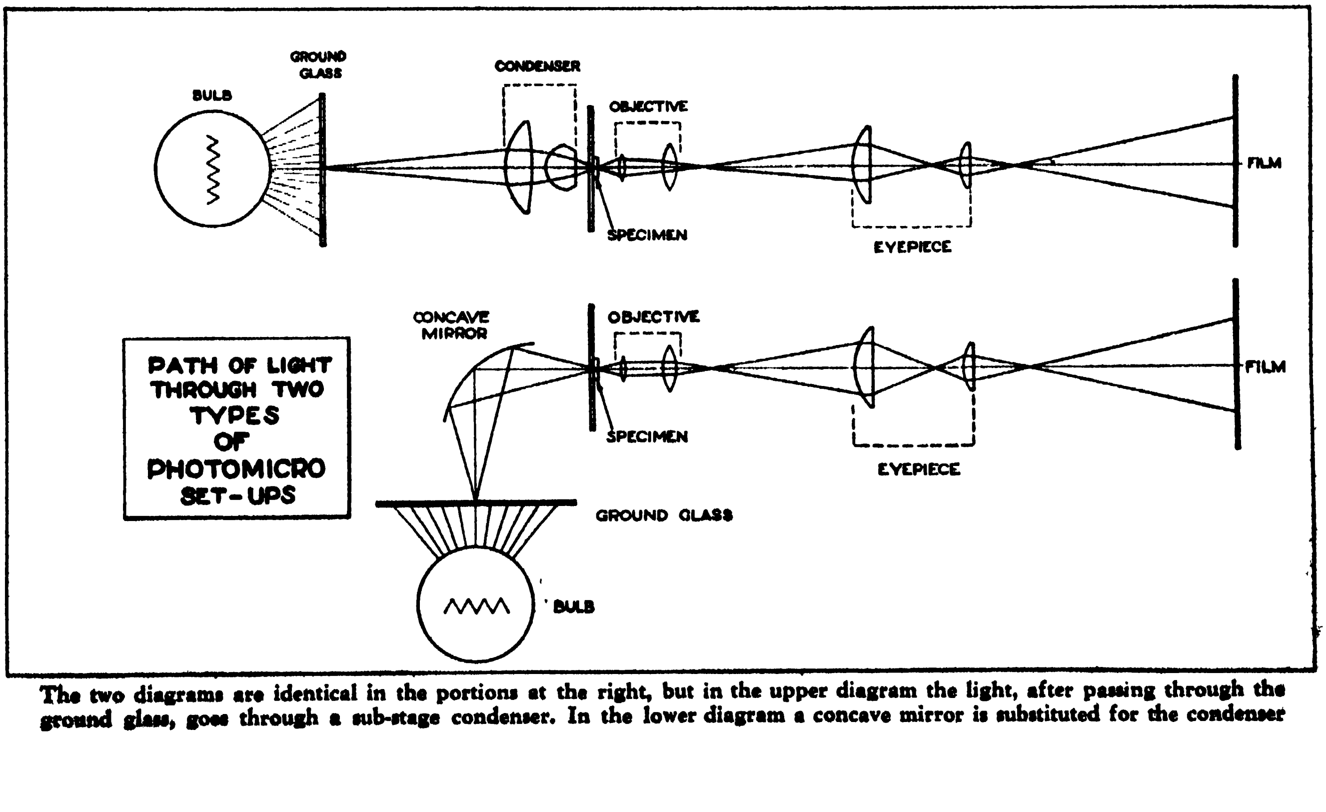

Diatoms, 375 X (reduced about one third in reproduction). Illuminant not properly centered and focused, causing unevenly illuminated field

Of course, the light source may be clear sky seen through a clear window. The microscope should be set close enough to the window, or in such a position that the window bars will not be imaged on the specimen by the mirror or substage condenser. If such a position is not convenient, a piece of ground glass about three or four inches square should be set up in front of the mirror, so that the light from the window will be diffused and thus eliminate the image of the window bars. In case a clear glass incandescent bulb is used for a light source, a ground glass or other diffusing medium should be set up between the light and the microscope. Otherwise the filament of the bulb will be focused on the specimen and be seen on the photographic plate. The ground glass is then considered as the source of light.

To adjust the illumination when sky light is not used, look into the microscope eyepiece and tilt the substage mirror until the maximum light comes into the field. Now focus the objective on the specimen on the stage. If the stage or substage condenser of the microscope is fitted with an iris diaphragm, leave this open. Place the point of your pencil against the ground glass at the center and, if there is a condenser, adjust it until the pencil point is in the best focus. If there is no condenser, move the ground glass toward or away from the microscope until you secure the same effect.

Remove the eyepiece of the microscope and observe the back lens of the microscope objective by looking through a pinhole diaphragm placed over the opening in the tube from which the eyepiece is taken. This pinhole diaphragm is made by simply punching a pin through a small piece of heavy paper or card, which is held over the center of the tube opening. When viewed in this manner, the back lens of the microscope objective should appear as a full disk, evenly filled with light. If such is not the case, readjust the position of the light source and the inclination of the mirror. If the microscope is one of the miniature types, the eyepiece may not be removable. In this case, a magnifier may be used to examine the image of the back of the objective (Ramsden disk) which is formed just outside the eyepiece where the eye is held for visual observation.

Now we can test and see whether we have done all of these things properly. If the illumination is properly adjusted and centered, the image seen in the microscope should remain stationary as we focus up and down. The points in the structure will appear to expand or contract as they go in and out of focus. When the illumination is off center, and the light is passing obliquely through the specimen into the objective, the image will have the appearance of "creeping" off to one side as we change focus. When the best focus is obtained, decentered illumination has a tendency to distort the actual appearance of the specimen and often leads to false impressions. This does not mean that oblique illumination cannot be used. Some specimens, especially



The two diagrams are identical in the portions at the right, but in the upper diagram the light, after passing through the ground glass, goes through a sub-stage condenser. In the lower diagram a concave mirror is substituted for the condenser

very tiny structures such as bacteria, are best seen with the light reflecting off their sides. However, exactly centered illumination is most generally used, and the amateur will soon determine for himself when it would be best to change this procedure.

Cheaper microscopes are not well corrected for color. Monochromatic light will offset this, and may be used to advantage in both visual and photographic work. Green is the best color to use. Obtain a green photographic filter, about four inches square, from any photo supply dealer. Lean this against the stage between the light and the mirror.

Now we are ready to snap the picture. Place the camera in position, with a light-tight connection between the eyepiece tube and the camera. Observe the image as it is projected on the ground glass of the camera; some slight focusing of the microscope will be necessary. Adjust the specimen so that the image is projected exactly in the center of the ground glass. To make the centering more convenient, it is well to rule cross lines with India ink on the ground glass, accurately placed so that the point of their crossing will be the exact center of the film.

THE shutter is now closed or, if the camera has no shutter, the illuminating source is turned or blocked off. Replace the ground glass with the film. Click the shutter or switch the light on and off, and there you have your first photomicrograph.

"Click the shutter" makes this part of your work sound simpler than it really is. Exposure time is just as important in photography with the microscope as it is in other kinds of photography. Many factors enter into the determination of the exposure time: the power of the light source, the amount of magnification, speed of the plate, the opacity of the specimen, and whether or not color filters are being used. All of these factors may make the exposure time extend from a "snapshot" of one fiftieth of a second to

Section of fibroid tumor, X 130. *Right:* Good resolution and proper appearance, due to critical illumination, proper centration, use of maximum aperture of objective. *Below:* Same, showing effect of closing sub-stage iris too far. Note blocking of detail, shrunken appearance of structure and a sort of shriveling at the edge of the field

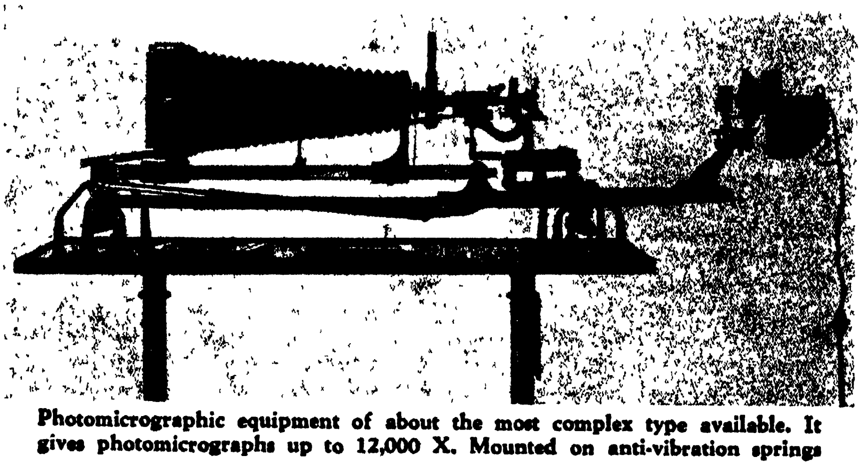
several hours. There are some highly complicated ways of figuring out the exposure time more or less precisely, but most amateurs and professionals simply use the trial and error method. As they make each exposure they note down all the conditions connected with it, and soon come to learn about what is best. (You will find that a photomicrograph of a fly's wing, using the 60-watt frosted bulb and roll film, such as Verichrome, will take about one second exposure.)

Because the exposure time is so uncertain it is advisable for the amateur photomicrographer to develop his own negatives and, perhaps, make his own prints. It is quite simple to do this in your own kitchen. You will have better results, save time and money and, above all, add to the fun of the thing. It all seems much more worth while if you can see the results of your work 10 or 15 minutes after making the exposure than if you have to wait while your photographic supply store does the job for you.

The whole outfit—"Beginner's Developing Outfits" as they are called—may be bought from your photographic dealer. But if you want to assemble it yourself, the following are necessary: A six-cent tube of MQ Developer, or its equivalent, which will develop two or three rolls of film; a half pound of acid fixer, which costs about 25 cents and makes up about two quarts of acid fixing bath and can be used for many negatives and prints; three photo developing trays, two just a little larger than the size of the film you use and one about 8 x 10 inches, for washing your prints; a safe light; graduate, stirring rod and thermometer; and some arrangement for making the prints. The directions for use are stated on each bottle of the developer. You will notice that the manufacturer has given the best developing time at a certain temperature. It is better to keep to this time.

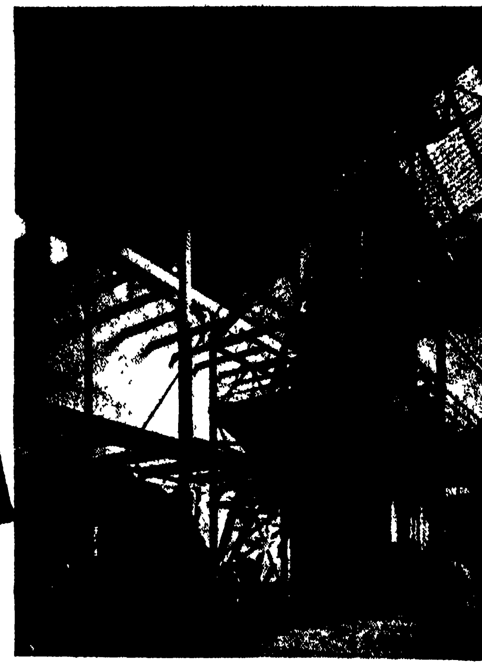
YOUR photographic dealer will be glad to give you any information you may need with regard to developing and printing films. Try making a photomicrograph just once and you will enjoy it so much that you will soon fall into the habit of feeling that you have not properly viewed a good specimen until you have seen your own photomicrograph of it. Start an album right away—and some day it will be one of your proudest possessions.

One more thing: It is very definitely "photomicrograph" and not "microphotograph." There are such things as microphotographs—curiosities that you may run across from time to time in some old collection of slides. They are photographs made on microscope slides and are so tiny that, to the unaided eye, they look like nothing much more than the period at the end of this sentence. Viewed under the microscope at fairly low magnification, they are exquisite miniatures of fine paintings or other subjects.



Photomicrographic equipment of about the most complex type available. It gives photomicrographs up to 12,000 X. Mounted on anti-vibration springs

EDITOR'S NOTE: *The Editor would be interested in seeing your photomicrographs. Send them along and, if you are agreeable, we may be able to publish some of them from time to time.*



Right: The head frame of the museum's coal mine stands 65 feet in height

Above: An entry to the main haulage-way of the mine. A low electric mine locomotive is at the left

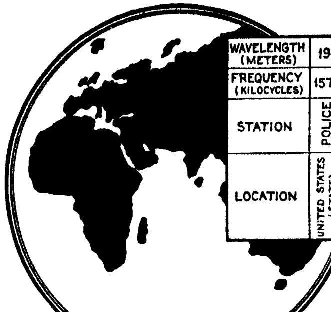
Circle: A miner, working with regular equipment, demonstrates how an undercut and shear are made

Above: A post drill boring holes into which explosives are to be inserted for bringing down large quantities of coal

Left: Working on a low seam in the mine. Notice in particular the special equipment that is employed for this work

Full-Size Coal Mine in a Museum

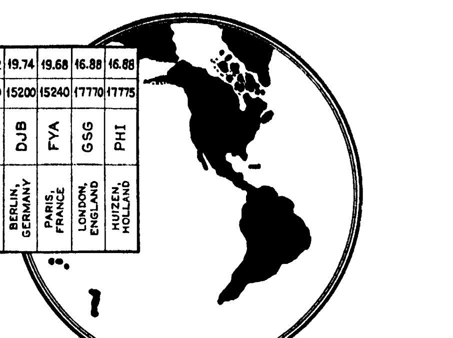
IN the rehabilitated Fine Arts Building, in Jackson Park, Chicago, which has now been practically rebuilt in permanent form, is an operating bituminous coal mine which constitutes the major exhibit in the Museum of Science and Industry, recently opened to the public. Much effort has been expended in this unique reproduction of a full-size coal mine, so that both the mechanical and geological details will be provided. On entering the Museum the most prominent feature is a huge mine hoist holding 500 feet of cable. The head frame rises 65 feet above the main floor. At three minute intervals the cage arrives to take 30 people into the mine itself and the skip dumps seven tons of coal, which has been raised from the shaft bottom. The visitors apparently descend for 500 feet. As the cage approaches the center of the shaft, the smell of the coal mine greets the nostrils. Arrived at the bottom of the shaft the group sees a rotary dump taking full-size loaded mine cars and turning them upside down. The visitors are shown various features of coal mining, are given a ride in a regulation mine train, and are taken to see the coal actually being mined. An artificial fire-proof coal has been provided which defies detection and a perfumer has produced a synthetic liquid which provides the odor of the mine. The artificial coal is prepared in a plastic state and is pressed against the walls of selected mines in order to obtain authentic surface markings and present fossil and geological formations for study at first hand.



WAVELENGTH (METERS)	190	175	167-150	124-120	77-75	70.2	50.21	50.0	49.83	49.59	49.5	49.26	49.26	49.10
FREQUENCY (KILOCYCLES)	1574	1712	1800-2000	2412-2506	3900-4000	4273	5968	6000	6020	6050	6060	6090	6090	6110
STATION	POLICE	POLICE	AMATEUR	POLICE	AMATEUR	RW 15	HVJ	RV49	DJC	GSA	VQ7LO	CP5	OXY	YV1BC
LOCATION	UNITED STATES (STATE)	UNITED STATES	*PHONE*	UNITED STATES	*PHONE*	KHABAROVSK, U.S.S.R	VATICAN CITY	MOSCOW, U.S.S.R	BERLIN, GERMANY	LONDON ENGLAND	NAIROBI, KENYA, AFRICA	LA PAZ, BOLIVIA	COPENHAGEN, DENMARK	CARACAS, VENEZUELA

WAVELENGTH (METERS)	49.02	42.86-41.1	38.48	32.26	31.55	31.55	31.51	31.38	31.30	31.28	31.26	31.25	30.43	25.64
FREQUENCY (KILOCYCLES)	6120	7000-7300	7797	9300	9510	9510	9520	9560	9585	9590	9595	9600	9855	11700
STATION	ZTJ	AMATEUR	HBP	CNR	GSB	VK3ME	OXY	DJA	GSC	VK2ME	HBL	XETE	EAQ	FYA
LOCATION	JOHANNESBURG, AFRICA	*MOSTLY CODE*	GENEVA, SWITZERLAND	RABAT, MOROCCO, AFRICA	LONDON, ENGLAND	MELBOURNE, AUSTRALIA	COPENHAGEN, DENMARK	BERLIN, GERMANY	LONDON, ENGLAND	SYDNEY, AUSTRALIA	GENEVA, SWITZERLAND	MEXICO CITY, MEXICO	MADRID, SPAIN	PARIS, FRANCE

WAVELENGTH (METERS)	25.53	25.51	25.4	25.29	25.21	23.38	21.2-21.1	19.84	19.82	19.74	19.68	16.88	16.88
FREQUENCY (KILOCYCLES)	11750	11760	11810	11865	11900	12830	14150-14250	15120	15140	15200	15240	17770	17775
STATION	GSD	DJD	I2RO	GSE	FYA	CNR	AMATEUR	HVJ	GSF	DJB	FYA	GSG	PHI
LOCATION	LONDON, ENGLAND	BERLIN, GERMANY	ROME, ITALY	LONDON, ENGLAND	PARIS, FRANCE	RABAT, MOROCCO, AFRICA	*PHONE*	VATICAN CITY	LONDON, ENGLAND	BERLIN, GERMANY	PARIS, FRANCE	LONDON, ENGLAND	HUIZEN, HOLLAND



When listening in for foreign short-wave stations, the important ones of which are listed in the above chart, the listener should always keep in mind the difference in time between his location and that of the desired station. The transmission frequencies of the *Jacob Ruppert* of the Byrd Expedition, not listed here, range from 6650 to 21,265 kilocycles

Around the World with SHORT-WAVE RADIO

By LOUIS MARTIN
Technical Director
Short Wave Radio Magazine

RECENT improvements in the construction of radio receivers have opened a new avenue of entertainment to the listener-in. Not many years ago, one of the big thrills of radio was to listen to a station a few hundred or even a thousand or more miles away. Then regular broadcasting settled down to a basis of providing consistent entertainment and the thrills of DX gradually subsided. Now, however, there is an opportunity to recapture the glamor of distance radio reception and on a much grander scale than ever before. The whole world is at the fingertips of the owner of a properly designed short-wave receiver: London, Berlin, Paris, Moscow, Tokyo, Melbourne, Little America—all at the twist of a dial.

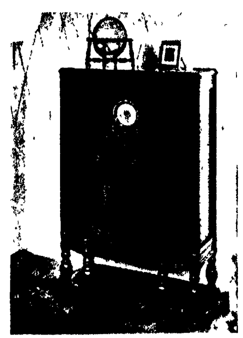
This tremendous increase in the scope of radio reception for the general public has been made possible by numerous improvements in radio circuits, an increase in the sensitivity and utility of vacuum tubes, and, most important of all, the development of manufacturing and adjustment processes of an accuracy heretofore unnecessary in the construction of standard broadcast receivers.

The sets which make possible long-distance reception on short waves are generally known as all-wave receivers. Actually, the majority of these receivers cover only those wavelengths from approximately 15 to 550 meters. This, however, is all that is necessary for the average person, as those wavelengths above 550 meters are mainly devoted to commercial traffic in code and therefore hold little entertainment value.

The design of a satisfactory all-wave receiver is an engineering problem of no mean proportions. To cover a wide band of wavelengths it is necessary to provide a series of separate tuning circuits, in order to avoid unbalancing and other undesirable factors which necessarily are introduced when a wide tuning range is obtained with a single circuit. In the all-wave receivers, the separate coils and condensers are progressively connected in the circuit by means of a selector switch which determines the wavelength band that can be covered by the dial. In one type of receiver, for example, the first position of the selector switch enables the tuning dial to cover the complete broadcast band. In the second position the range covered is from 75 to 200 meters, and so on down to 15 meters. On the face of the dial are several different scales, one for each wavelength range. This combination of mechanical parts and electrical circuits provides simplicity of operation and convenience and rapidity of switching from one range to another.

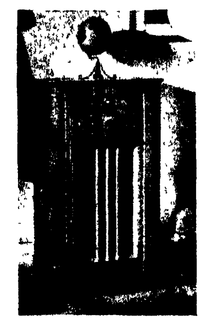
IT may be difficult for the layman to understand how it is possible to pick up broadcast stations from foreign lands with comparative ease when he may find it impossible to receive Los Angeles from the east coast on his broadcast receiver. The answer lies in the fact that radio waves below the broadcast band carry better than do the longer wavelengths. It is interesting to note this apparent anomaly: The sensitivity of most all-wave receivers is greater when the selector switch is in the broadcast position; the sensitivity becomes less and less as the receiver is tuned to a lower wavelength. However, due to the characteristics of short waves, far greater distance reception is possible in these bands, even with the decreased sensitivity of the receiver.

There are other peculiar things about reception on the shorter wavelengths. For example, there is the so-called "skip distance." On wavelengths around 50 meters, reception is most reliable at a distance of perhaps 300 miles or more from the transmitter. Within a radius of 75 miles of the transmitter, reception may also be fairly good, but between 75 and 300 miles reception is often impossible or at best is unreliable. This skip distance, with variations in the actual figures, is to be found on all of the shorter wavelengths and will often account for inability to receive domestic stations while at the same time foreign reception is excellent.

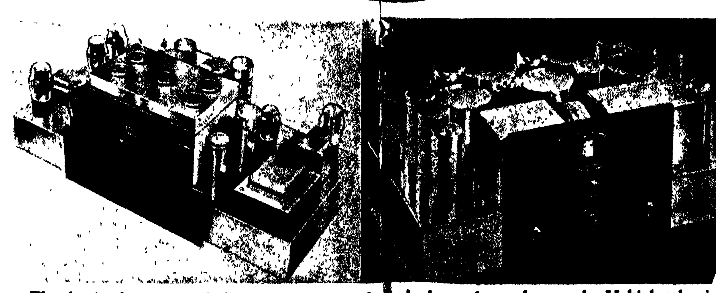


A circular tuning dial with four different scales is a feature of this particular all-wave receiver

An all-wave receiver being operated by Admiral Richard E. Byrd in the cabin of the *Jacob Ruppert*. This same receiver is now in the encampment at Little America



A globe is a valuable adjunct to the operation of an all-wave radio receiver



The chassis of two types of all-wave receivers are shown in the two lower photographs. Multiple tube circuits assure ample sensitivity and selectivity for 'round the world reception, and careful shielding reduces undesirable noises. Accurately balanced tuning circuits, connected to selector switches, make it possible for the operator to change rapidly from any one of the wave-bands to another with a minimum of trouble

This so-called skip distance is caused by the action of the Heaviside layer which, because of its varying height above the surface of the earth, is also responsible for the phenomenon known as fading. In modern all-wave receivers, however, actual fading—when the signal does not disappear entirely—is taken care of by automatic volume control. When the signal is strong the sensitivity of the receiver is automatically reduced; when the signal starts to fade the sensitivity automatically increases by an amount necessary to make up for the difference, with the result that the volume from the loudspeaker remains practically constant.

THE operation of an all-wave receiver, when the band selector is set for one of the shorter wavelengths, is somewhat different from that of the ordinary broadcast set. Because of the wide range of frequencies covered by the tuning dial on the short waves, the tuning is extremely critical or sharp. Even a station that comes in with ample volume will often be passed over without a sound if the tuning dial is not rotated very slowly. The amount of care which must be exercised in tuning on the short waves is indicated by the following quotation from the instruction sheet furnished with one of the best all-wave receivers now available: "Advance the volume control to a position near the middle of its range and rotate the station selector until the dial indicator assumes a position coincident with the listed frequency of the desired station. . . . Then turn the selector *very slowly* over a narrow range on each side of that setting, advancing the volume control further in a clockwise direction and repeating the tuning process if necessary until the signal is heard."

Aerials for use with short-wave receivers should be very carefully installed. Particularly must they be well insulated from all objects and must not run close to, nor parallel with, electric circuits either inside or outside the building. Static on short waves usually gives little trouble, but so-called "man-made" interference, such as street railway lines, automobiles in motion, oil burner installations, and so on, often create undesirable noises. This trouble can be minimized by erecting the aerial as far as possible from such sources of interference. Generally speaking, the aerial should have a length of from 25 to 75 feet, including the lead-in and ground wire. In some locations shielded aerials may be necessary for best results. Indoor aerials will sometimes be found satisfactory in buildings of non-metallic construction.

Because of the facts which have been determined about short-wave transmission and reception within the last year or so, and also because of refinements in manufacturing, radio set makers are now in a position to guarantee foreign reception. The consistency of this reception cannot be guaranteed, however, but under ordinary conditions and in a good location, a well-made all-wave receiver will prove to be a source of much enjoyment and unusual entertainment. When foreign stations do not come through with all of the volume and quality desired, it is always possible to turn to the aircraft and police bands. Here there is no entertainment as such, but there is adventure—the thrill of listening, in your easy chair by the radio, to the stern realities of police and aerial transport work as exemplified by their routine but exciting radio communications.

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Due to unforeseen circumstances, the article "Scientific Angles of Angling," scheduled for this issue and announced on page 226 of May, had to be held over and will appear next month. We can assure you that it will be worth waiting for.—The Editor.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

Golf Ball with "Shot in the Arm"

ONE of the main essentials of a long distance golf ball is high pressure at the core, which provides the necessary high elasticity under impact of the club head. This pressure, exerted on the liquid sac which constitutes the core, is built up by the winding over the core of a continuous thread of rubber under tension.

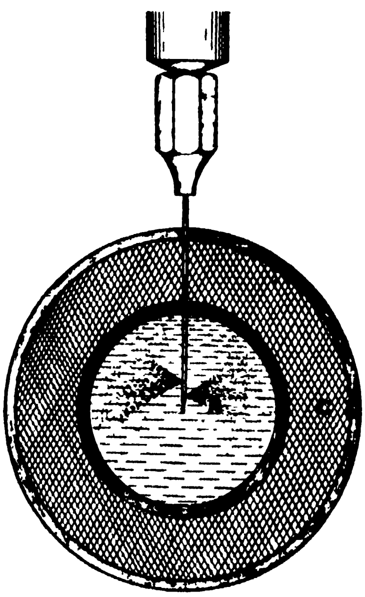
The cover is then applied over the winding by a moulding process which seals the two halves. In the case of long distance, softer cover balls, the moulding temperatures are not high enough to cause loss of tension on the winding, and in consequence an internal pressure of 1500 to 1600 pounds per square inch is retained in the finished ball.

An operator treating golf balls to increase internal liquid pressure

When the tough cover of cut resisting balls is applied, however, much higher temperatures are required. The result is a loss of a part of the tension on the rubber winding, the effect of heat on stretched rubber, and a consequent loss of a part of internal pressure. The result is a ball which, while having a cover that is practically proof against cuts, at the same time has a distance from 7 to 10 yards less than its softer covered brother.

Here was the problem—how to restore the lost pressure and still retain the tough cover. Obviously it was a job that had to be done after the ball had been completed, since the loss of pressure was an inescapable result of the vulcanizing process. The problem was solved as follows:

A hollow steel needle, similar to a fine hypodermic needle, is thrust through the cover, through the rubber thread windings, and into the liquid center. An added quantity of liquid—exactly six one-hundredths of an ounce—is forced in under high pressure. Immediately an initial pressure of 800 pounds is raised to about 1400 pounds, being what the ball really needs to get maximum distance.



How the ball gets its "shot"

Freshness of Fish Indicated by Voltage

BY measuring the "voltage" of a fish, its relative freshness may be determined, says *Food Industries*. Around this discovery, Maurice E. Stansby and James M. Lemon, scientists at the Gloucester, Massachusetts, station of the Bureau of Fisheries, have worked out a method for finding out how long non-fatty fish, such as haddock, may be expected to keep.

The test is conducted in two steps: The first is to neutralize the basic decomposition products in the flesh with acid; the more acid required for immediate neutralization the greater the decomposition. The second step is to determine the amount of protein breakdown present. This is done by adding more acid after neutralization of basic decomposition products and observing the ability of the flesh to combine with it. Flesh from a fresh fish combines with more acid than that from one in which considerable protein breakdown has occurred.

To determine the acidity of the fish, the flesh is chopped and mixed with water. Quinhydrone is then added and a platinum electrode is dipped into the mixture. The electromotive force produced by this half cell, as measured against a reference electrode, is proportional to the acidity.—*A. E. B.*

Electric Erasing Machine Held Like a Pencil

A NEW electric erasing machine, light, compact, and durable, is announced by Charles Bruning Company, Inc. The new machine is designed to be held in the fingers like a pencil, rather than in the fist, and thus to enable the operator to maintain

A small electric motor drives the draughtsman's high-speed eraser

accurate finger control when erasing pen or pencil lines from tracings or drawings. The machine is operated by a self-contained electric motor operating on 110 volts.

Dr. Clement Cleveland

DR. Clement Cleveland, surgeon director emeritus of Woman's Hospital and consultant surgeon for 52 years on the staff of the Memorial Hospital, New York City, of which he was a founder, died April 16, 1934.

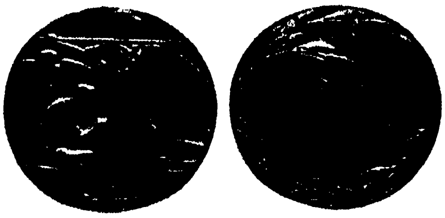
Dr. Cleveland, a second cousin of President Grover Cleveland, specialized in gynecology and was one of the leaders in his field a generation ago. He was the inventor of many surgical instruments and appliances, the most noted of which was known as the Cleveland Operating Table. He also devised a ligature carrier which had wide use, and modified the speculum for gynecological work. Dr. Cleveland was born in Baltimore in 1843.

Cedarized Containers Don't Stop Moths

THE mere odor of cedar does not protect clothing from moth attack. Cedarized cardboard closets and cardboard boxes offered the public for protecting winter clothing and blankets against clothes moth damage will not in themselves safeguard the articles stored in them. During the past summer and fall entomologists of the United States Department of Agriculture made tests of closets and chests impregnated with cedar oil or cedar chips, and the results indicated that many of these containers are worthless when used in accordance with the instructions issued with their sale.

The experiments also proved that moths have no difficulty in crawling into most kinds of cardboard containers, unless all cracks, holes, and gaps are sealed with adhesive tape or heavy gummed paper, or unless the box is wrapped in an outer covering of strong unbroken wrapping paper so folded under at the ends that no moths can get in. Otherwise, once inside, the females lay many eggs and the eggs hatch into worms, which are not killed by the cedar odor, but continue to grow and cause much damage by feeding on the materials stored.

The specialists of the Department do not believe that such cardboard closets and boxes can be depended on for moth protection unless the articles stored in them are sprinkled plentifully with flake naphthalene or paradichlorobenzene crystals and the cracks about the doors of the closets and lids of the boxes carefully sealed with adhesive tape.



Orson D. Munn, Editor of *Scientific American*, presenting the Arthur Williams Medal to Captain Flavel M. Williams, in recognition of the work which he has done in developing the fog navigating camera which increases safety at sea. Medal shown at left

Medal Awarded for Fog Navigating Camera

THE Arthur Williams Medal, awarded through the American Museum of Safety, was recently presented to Captain Flavel M. Williams for the invention of the infrared navigating camera which was described on page 120 of the March 1934 issue of SCIENTIFIC AMERICAN. The award was made at a luncheon on the S. S. *Manhattan*, the same ship on which the fog navigating camera has undergone a series of extensive tests.

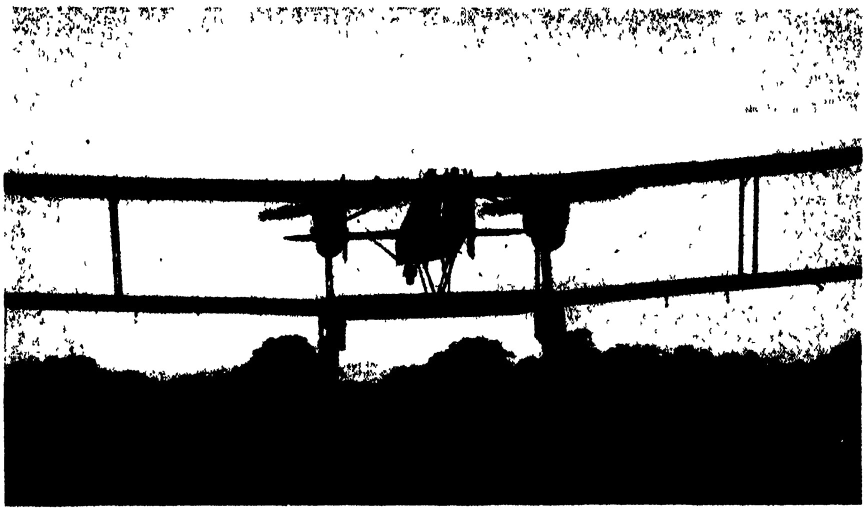
This recognition for the work which Captain William has done was accorded him as the result of a recommendation made by Mr. Albert A. Hopkins, Associate Editor of this magazine. Captain William's camera had been explained to us in confidence some months ago. At that time the recommendation was made and the proceedings were started.

SCIENTIFIC AMERICAN's interest in safety at sea dates back many years and is amply evidenced by awards which have been made in the past in recognition of efforts to decrease dangers of ocean travel. It was in furtherance of this interest that SCIENTIFIC AMERICAN concerned itself with the award of the Arthur Williams Medal.

This scene from a recent motion picture certainly looks frigid, but in reality, it was taken on a warm California day. The chemist co-operated with the director in producing "ice" from sodium hyposulphite which can be used for skating

Growing Pains

JACOBI gave the theory of growing pains the strongest blow when, in 1884, he announced that these vague, ambiguous pains in children are probably associated with rheumatism. He clearly saw the clinical relationship between growing pains and articular rheumatism and even endocarditis. He noted that uncomplicated muscular rheumatism is rare in young children, and at that time he wrote: "'Growing pains' are not infrequently inflammatory rheumatism, and endocarditis of later years may be traced back to the growing pains which are but dimly remembered." There is no real



A Handley Page Heyford bomber with excellent defense against small planes

evidence to substantiate the old idea that normal growth causes chronic muscular pains. There is timeliness in the contention that the term "growing pains" is a misnomer and should be discarded. Chronic pains in the muscles which can be differentiated from chronic fatigue and definite orthopedic disorders are probably the result of a chronic infection. Many of the muscular pains may properly be classified as the muscular rheumatism of childhood.—*Journal of the American Medical Association.*

Is the Airplane a Danger to New York City?

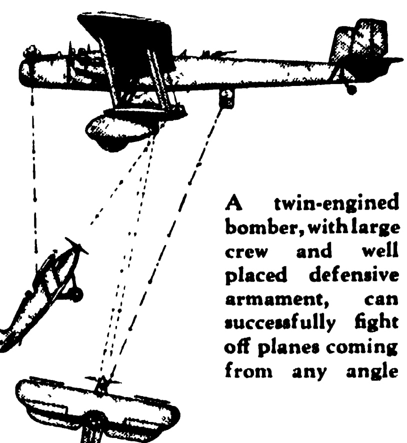
THE well known British aircraft constructor, Handley Page, points out that the large twin-engine bomber has tremendous war-time possibilities in the shape of 2800 pounds of bombs, with a destruction radius of 100 yards, a range of 510 miles in 3½ hours, and ability to operate at 15,000 feet, out of reach of most anti-aircraft guns. Moreover, the twin-engine bomber such as the Handley Page Heyford shown in one of our photographs can fight off the speediest single-seater fighter. Thanks to its fore-and-aft guns, the attacker is always within the angle of fire of the bomber, and since the bomber gunners have nothing to do but shoot and are not bothered with piloting at the same time, their aim is likely to be more deadly than that of the lone pursuit pilot.

The case for such aircraft is, then, that the bomber is deadly, and can withstand the efforts of the defense. Why would not a bomber be therefore a most deadly weapon against a modern city?

Major General H. G. Bishop, writing in *The New York Times* has much to say in rejoinder. The General can handle his pen as effectively as his sword. We quote from his article: "More than 40 percent of the area of the average American city is unoccupied space—streets, alleys, parks, and vacant lots. A projectile without correct aim, therefore, has little more than a 50-50 chance of hitting a building. The physical damage that a 500-pound high-explosive bomb would do in either case is highly conjectural. Unless the bomb is accurately placed more than half of its effect is lost.

"Aimed bombing, in which the intention is to hit a definite object, is a complicated process requiring special apparatus and highly trained operators. The instant a bomb is released from a ship, it has the velocity and direction of the ship. Gravity, wind, and other disturbing factors instantly act to change this motion and its intensity. Hence it is necessary in aimed bombing that the ship is traveling at a known or predetermined speed—also it must travel upon a predetermined course and at predetermined altitude . . . The greater the altitude of release the more are the errors in the necessary calculations multiplied."

Visualizing a bomb attack upon New York City the General says: "If it hit the Empire State Building . . . only a few of the topmost floors would be wrecked."



A twin-engined bomber, with large crew and well placed defensive armament, can successfully fight off planes coming from any angle

Further discussing the attacking fleet: "Such a fleet must have a secure base within 300 miles of the city of its objective, where the ships may be repaired, serviced, and loaded."

The General concludes that bombing operations against cities will be far less dangerous than is often taken to be the case. He cites history to show that every new weapon of offense has been met by a new weapon of defense.—*A. K.*

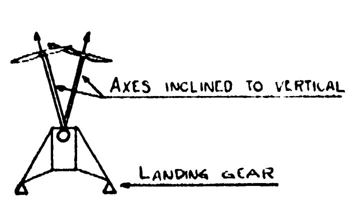
The Latest in Helicopters

PHOTOGRAPHS of the Florine helicopter have recently appeared in European newspapers, with unfortunately very little in the way of descriptive material. The helicopter has been built by Nicolas Florine, a Russian who is now a naturalized Belgian subject, under the auspices of the Belgian Aeronautical Service. The new machine has remained in the air for nine minutes and 58 seconds, a world's record, but nothing is available regarding the forward speed.

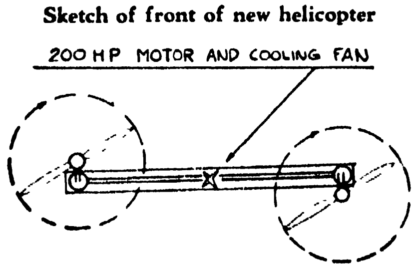
In this craft, the two lifting airscrews are driven by gearing from a central air-cooled engine. Above the engine there is a small airscrew which serves to cool it. The pilot sits in the open trusswork, which is of steel tubing. The landing gear is composed of four symmetrically disposed and designed pads or "footballs," so that it does not matter which way the machine lands. The gross weight is about 1500 pounds, and the motor develops 200 horsepower at full power, of which only 160 is normally utilized. Each of the lifting airscrews has a diameter of 23½ feet.

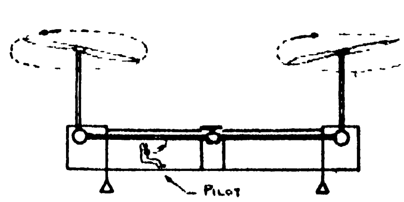
We imagine that the control of the helicopter depends on the pilot's ability to change the pitch of one or other of the airscrews. Suppose that the forward airscrew has its positive pitch slightly diminished. Its lift will decrease and the craft will nose downwards. Immediately a forward component of thrust will be brought into play, giving the helicopter a measure of forward speed. This is only a first elementary hypothesis, however. The question of lateral control and of steering probably also depends on suitable pitch variation and the forward speed is likely to be low.

There is one very important difference between the Florine helicopter and all other direct lift machines to date. In previous designs, two airscrews are employed rotating in opposite directions. The airscrew is turned by torque from the engine, and therefore—action and reaction being equal and opposite—it exercises a turning moment on the aircraft. If only one screw were employed, or two screws turning in the same direction, the aircraft as a whole would turn 'round and 'round to the discomfiture of the pilot. In the Florine machine, both screws turn in the same direction. How then is this disturbing spinning effect eliminated? Since the airscrews are inclined to the vertical in opposite directions, as illustrated in our sketches, the



Sketch of front of new helicopter





How the lifting screws and motor are placed in the Florine helicopter

horizontal components of the thrusts set up a turning effect equal and opposite to the motor turning effect.

Our readers may ask: What is the advantage of such a design? The advantage is that in this manner the gyroscopic effects of the two airscrews do not neutralize one another, and the gyroscopic effects tend to give the helicopter stability, which is a very important point.

The first flights have shown such stability, and also ease of control. Therefore more detailed information will be awaited with interest.—*A. K.*

Stark on Instrument Flying

A LITTLE pamphlet by Howard C. Stark on instrument flying now reappears as a text-book and is a very welcome addition to the meager literature on the subject. Mr. Stark is a veteran and skilled transport pilot; his book and system of instruction have gradually evolved out of his own experience.

As illustrated by one of the drawings, an airplane has six degrees of freedom. It can move along three axes: Forward along the X axis; up or down along the Z axis; sidewise along the Y axis. Also, it can turn about each of these three axes: Pitch up or down about the Y axis; turn or yaw about the Z axis; and roll or bank about the X axis.

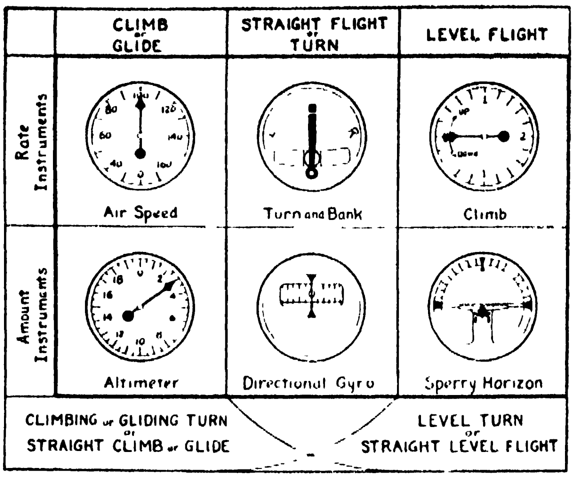
Flight instruments can be classified into two groups as follows: 1. Those which show the *rate of motion* along these axes, or the *rate of turn*; 2. Those which show the *amount of motion* along these axes or the *amount of turn*. Mr. Stark's Aircraft Instrument Classification table, the first ever presented, is reproduced in these columns. Twelve indications are thus needed to complete the pilot's knowledge of the airplane's motion.

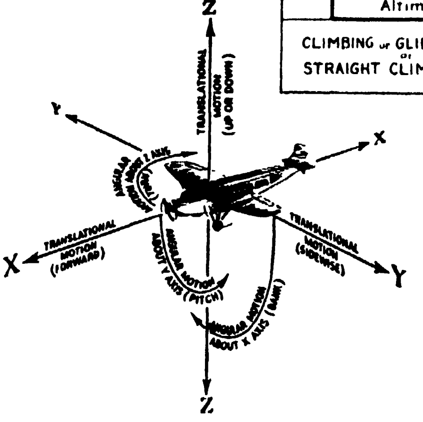
A typical arrangement of seven instruments which give all the necessary indications is shown in one of the photographs. The air-speed indicator shows how fast the aircraft is traveling; the drift indicator not so frequently employed shows the speed in a lateral direction; the rate of climb indicator how fast the airplane is moving up or down. Hence they are properly classified as *rate* instruments.

The radio signaling system and the radio beacon show the distance traveled along a course or the amount of deviation from the course. The altimeter shows how much the airplane has risen or fallen. Radio aids and the altimeter are therefore properly classified as *amount* instruments.

The ball of the bank indicator should stay in its central location for a correctly made bank—when the centrifugal force is correctly balanced by the inclination of the ship. The turn indicator is based on indications of the air pressure at either wing tip, transmitted to a pressure gage, and therefore shows the rate of turn. The pitch indicator is similar to the bank indicator and shows approximately the rate at which the plane is nosing up or down. These, therefore, are *rate* instruments by a broad interpretation.

Right: **Chart showing the instrument combinations used in blind flight.** ***Below:*** **A plane in the air has six degrees of freedom and can move along three axes. See the text**





The Sperry Horizon is based on the vertical position in space maintained by a gyroscope and therefore shows the *amount* of displacement from the vertical in either a longitudinal or a transverse plane. The directional gyro does the same for angular displacement from the true course, and so does the compass.

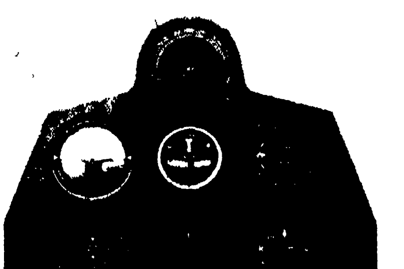
Another drawing shows the instrument combinations actually used in blind flying. If correctly interpreted they give the pilot complete aid in blind flying. Such correct use is no longer a matter of the pilot's own experience or inspiration. Certain definite rules must be followed.

For the rate instruments the following 1-2-3 order applies for returning to or maintaining straight level flight:

1. Center the turn indicator with rudder only. The ship is then no longer turning.
2. Center the bank indicator with ailerons only. Since the ship is no longer turning, due to maneuver 1, a central position of the ball means that the plane is on a level keel.
3. Center the climb indicator and control the air speed indicator with elevators only. Maneuvers 1 and 2 have set the ship straight directionally and laterally. Maneuver 3 insures level horizontal flight.

Maneuvers 1 and 2 must be carried out in very close coordination. The use of too much rudder without the coordination of the ailerons will cause skidding; that is, undesired lateral motion.

The use of the amount instruments is more direct and natural and requires less rigid rules, since they give at all times a direct and continuous picture of the position of the airplane. All the pilot has to do is to keep the miniature airplane of the Sperry Horizon parallel to the horizon bar. If the miniature airplane is thus held parallel the directional gyro gives assurance that there is no turning off the course.



An airplane instrument board with the seven necessary instruments

Cross-checking is possible between the rate and amount instruments. A pilot who has learned the 1-2-3 order and the system of cross-checking should be moderately happy even in the thickest weather.—*A. K.*

AIRCRAFT INSTRUMENT CLASSIFICATION

AXES	MOTION	RATE INSTRUMENTS	AMOUNT INSTRUMENTS
TRANSLATION			
1. Longitudinal	Forward	Air Speed Indicator	Radio
2. Lateral	Sideways	Drift Indicator	Radio
3. Vertical	Up and Down	Rate-of-Climb Ind.	Altimeter
ANGULAR ROTATION			
4. Longitudinal	Roll or Bank	Bank Indicator	Sperry Horizon
5. Lateral	Pitch	Pitch Indicator	Sperry Horizon
6. Vertical	Turn	Turn Indicator	Directional Gyro Magnetic Compass

Weather Broadcasts Aid Motorists

WEATHER information disseminated for airmen by the Department of Commerce also aids automobile drivers in planning trips, according to information received by the Department from agencies which furnish route information for travelers on the highways.

Comments upon this use of weather broadcasts have been received by Rex Martin, Assistant Director of Aeronautics in charge of the air navigation division, as a result of his suggestion that radio manufacturers offer automobile receiving sets capa-

ble of receiving the frequencies upon which these reports are broadcast.

The Beacon National Tourist Bureaus reported that since it had arranged, in 1930, to obtain the airways reports, it has supplied meteorological information to more than 20,000 motorists.

A letter from the Nashville Automobile Club said: "Accurate weather and precipitation conditions influence many routings and the public is growing more and more to demand weather facts. We are grateful that we have you on whom we may call for changing conditions. The government has done a great thing for the automobile as well as the air traveler in establishing radio stations. More than once to our certain knowledge discomfort or even hardship and suffering have been averted by accurate information given by you."

A special portable ladder used in the shops of Eastern Air Transport at Atlanta, Georgia. With this ladder it is easy to reach many out-of-the-way parts of an airplane for complete inspection or maintenance

New British Airliner

WE have become so accustomed to transport airplanes of the low wing cantilever type, without external bracing, that a biplane with struts and wires seems a little old-fashioned, but the British de Havilland 86, by its excellent performance, demonstrates that the old biplane principle can still be usefully employed.

The British are rapidly pushing the extension of their Asiatic services to Australia and the D.H. 86 is to be put into service between Singapore and Port Darwin in New South Wales, Australia. It has a maximum speed of 170 miles per hour, a cruising range of some 460 miles, and is to carry ten passengers, a crew of two, and complete passenger, wireless, and navigation equipment.

The first point of interest is the use of four engines (Gipsy six-cylinder of 184 to 205 horsepower), all faired carefully into the lower wing. Even with four engines the total horsepower is moderate compared with American standards. If a multiple power plant adds to safety, then the use of four engines is desirable in spite of increasing complexity. With one engine out of commission the plane can fly indefinitely; even with both engines on one side out of commission the ceiling is 3600 feet.

Another interesting feature is the use of very large aspect ratio. With cantilever monoplanes, the aspect ratio (which may be roughly defined as the ratio of span to chord of the wing) is generally around 6. Here the aspect ratio is 12.3. This aspect ratio is possible because the wing is supported by struts and wires. Furthermore, the wings are tapered, which is far from customary in a biplane. As a result of the taper, only one strut between the wings is necessary at the tip, although two struts are placed between the wings farther inboard. The result is that the biplane cellule is as efficient aerodynamically as the short aspect ratio monoplane. (Efficiency, of course, increases with aspect ratio.) The fuselage is nicely streamlined and occupies the entire gap between upper and lower wing.

In spite of the excellent performance figures, the power loading is high; namely, 11.2 pounds per horsepower, a far higher figure than American practice indicates. *-A K.*

The Navy Takes Up Gliding

THE Navy's most enthusiastic and skilled glider pilot, Lieutenant Commander Ralph S. Barnaby, has succeeded in his intelligent and persistent campaign. Henceforth half of each incoming class at the Pensacola air-training station will undergo their elimination period in a course of glider training. Until recently all candidates for Pensacola were given preliminary airplane instruction at Hampton Roads or San Diego, and undesirable students were weeded out by this process. The procedure was costly and required 30 days of intensive training.

Now, four selected officers employing two gliders will eliminate men as a result of the glider training course. The methods to be employed will be similar to the usual practice of most of the gliding schools of the country. The student is towed behind an automobile at the end of a 1000-foot cable. At first, while mastering the rudimentary maneuvers such as keeping wings level and using rudder to prevent turning, he is allowed to rise only a few feet off the ground. Gradually the altitude is increased until at an altitude of 600 feet in the air, the student cuts loose from the cable. At this altitude he is able to perform such maneuvers as S-turns, figure eights, spirals, and precision landings.

Several advantages are claimed for the new system. After about 38 "drags" behind the automobile, the student can perform all such maneuvers with ease, and these drags take only a fraction of the time and expense that airplane training would involve. Further, the glider pilot develops complete

Official Photograph, U S Navy

Lt. Comm. Ralph S. Barnaby who advocates glider training for flyers

confidence. From the first the glider student goes into the air alone, is entirely dependent on his own resources, and corrects his own errors. When the time comes for him to solo an airplane he has already been in sole control of a heavier-than-air craft. Self-confidence is perhaps the greatest asset that a pilot can have. Again, as the glider pilot flies "by the seat of his pants," as H. Latane Lewis puts it, he is more likely to develop an air sense.

There are some drawbacks to the method. The technique of the engine, particularly the troublesome effects of engine torque, is not absorbed in a glider. The glider can be landed almost anyhow without damage and this militates against good landings

The new British airliner described on this page

with a powered aircraft. Glider training is not dangerous but minor damage to equipment is all too frequent.

Nevertheless the plan is working out nicely, and Barnaby is still of the opinion that the Navy will save expense and weed out unlikely men with less danger and trouble.—*A. K.*

Steam Turbine for Aircraft

DESIGNERS of large seaplanes always turn longingly to the possibilities of large steam units. Most reciprocating steam engines are evidently out of the question because of their complexity and weight. Gas turbines are still a matter for the distant future, because the materials we have available to-day will not withstand the enormous gas temperatures. The steam turbine seems most appealing Here the difficulty lies in the size of the boiler and in the condensation problems. An ingenious solution is described in *Flugsport* The small 20 horsepower unit which has been developed is illustrated in our diagram.

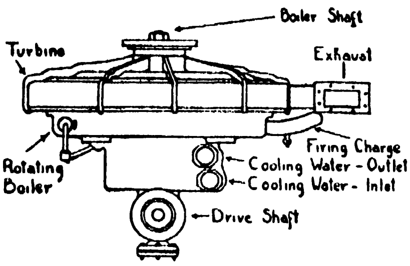


Diagram showing the important parts of the turbine for aircraft

The boiler itself rotates! This is the first time we have ever heard of a rotating steam boiler. It revolves on the same axis as the turbine proper, but in the opposite direction so as to take up the reactions at the issuing jets. Owing to the fact that the boiler (consisting of a series of U-tubes) rotates within a stationary housing, heat transmission from the burning gases to the water inside the tubes is rapid, and the boiler is small and gets up steam quickly. The necessary steam pressure is secured by the action of centrifugal force Condensation takes place within the machine itself, and the radiator is used only for cooling purposes just as in the internal combustion engine.

Our diagram illustrates the compactness and simplicity of the new engine, which while rated at only 20 horsepower, can stand an overload of 100 percent and can be run 8000 hours without overhaul. -*A. K*

Unshrinkable Fabrics

UNSHRINKABLE fabrics seem to be within reach of the textile manufacturer as a result of long research by the Cluett, Peabody Company which has finally placed the process of shrinking upon a scientific basis. In the new process, the finished cloth is passed through an ingenious mechanism comprised of detensionising or compressing surfaces, which grip it and exert enormous compressional force in a direction parallel with the cloth face. In other words, the threads which have been previously pulled out are pressed back to any predetermined degree. As the behavior of every type of fibre under manufacturing conditions is known, it is a matter of simple calculation to find the degree of compression required for any fabric.

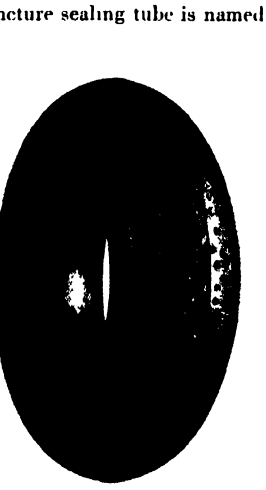
An interesting feature of this new process is that the appearance is improved, and the cloth becomes softer, handles more pleasantly, and is given a beautiful lustre.—*A. E. B.*

Inner Tube Improvements

TWO new passenger car tire tubes, one of which will not be cut to ribbons if run flat, and the other a puncture sealing tube incorporating new principles for a product of this kind have just been introduced by The B. F. Goodrich Company, Akron, Ohio.

The first is made of specially compounded yellow and black rubber in two sections. The entire tube is first made of one tough rubber stock, and then a layer of abrasion resisting rubber is vulcanized over the inside circumference of the tube This strip is made to give resistance to chafing at points where the most chafing action occurs, and afford double protection from common causes of tube failure.

The puncture sealing tube is named Seal-O-Matic It is believed entirely different in construction from previous products of this type, incorporating a layer of plastic gum rubber inside the tube wall. This rubber, specially compounded for this one purpose, flows into any hole that may be driven into the tube without allowing the tube to lose the air. The tube, in contrast to other products of this type, is so light that it can be used on the smallest cars, allowing them to ride as easily as on ordinary tubes.



Above:* How holes are sealed in new inner tube when deliberately punctured as at *right

Competition in Kegs

WHITE oak has long been the preferred wood for the manufacture of beer barrels. According to the United States Forest Products Laboratory, there are abundant sources of red oak that might profitably be used for this purpose. Laboratory authorities state that for beer barrel purposes the properties of red and of white oak are similar in most respects. The outstanding difference that has hitherto barred red oak is that in white oak most of the pores in the tree become plugged by a natural deposit called "tyloses" whereas in red oak no such filling-in occurs; hence the problem reduces itself to one of practical means of plugging the open pores of the red oak.

Accordingly, the Forest Products chemists have developed a process of stopping the pores of the red oak by filling them with a suitable form of pitch, under pressure.

Commenting on this achievement, *Food Industries* says editorially (and a bit ironically) that "steel has no pores, either" - a reference to the growing popularity of stainless steel kegs for the shipment of beer.—*A. E. B*

No Waste Between Toots

LOCOMOTIVES of the Canadian Pacific Railway will no longer show "the white feather," due to a repair program recently put in force.

The wisp of steam escaping from the top of many engines is called by that name by railroad men. A thing of beauty to the public, it is considered a waste by the operators who fix the blame on the wearing down of the valve seat of the whistle. Now the efficiency engineers are having the old type of seat replaced by Monel metal so that there will be no waste of steam between toots

Today's Common Drinking Cup

YOU may have thought that the dangerous disease-carrier, the common drinking cup, had disappeared. But it has merely changed its form and still endangers your health in a most insidious way. The editor of the *American Journal of Public Health* calls attention to its fresh menace·

"The common drinking cup has never really been abolished. We still have it, though not in the same form as before. Now

it is in the form of glasses, dishes, and tableware inadequately cleansed between servings.

"Go to almost any soda fountain, in any city; watch the attendant pluck a glass from the counter, swish it about hastily in a basin of muddy-looking tepid water, rinse it quickly in cold water, then use it to serve another customer.

"That glass is worse than the common drinking cup! Its superficial washing has served only to bring it into contact with germs from many other glasses 'washed' in the same water.

"Influenza, the common cold, tuberculosis, pneumonia, scarlet fever, diphtheria, whooping cough, and Vincent's angina, are

among the principal diseases that can be transmitted by unclean eating utensils. Pathogenic organisms (disease germs) are not removed by common methods of washing. After they are used and hand washed, more than 20 percent of the organisms remain adhering to eating and drinking utensils.

"About 92 percent of all communicable diseases are transmitted through the mouth and nose. Surely there is no better place to break the chain of saliva-borne and food-borne infections than at eating and drinking places.

"Clean food, clean hands, clean dishes: These three hold great hope for the control of saliva-borne infections."—*Science Service.*

Steinmetz Smoked Even When Swimming

THIS accompanying picture of Dr. Charles Proteus Steinmetz, known as "The Modern Jove" because of his pioneer work in artificial lightning investigations,

A hitherto unpublished photograph of the late Charles Proteus Steinmetz

shows this great scientist carried his cigar even while swimming. This picture, heretofore unpublished, was just found in Steinmetz's private collection of photographs.

Dr. Steinmetz, who died 10 years ago, would have been 69 years old on April 9. In tribute to his memory Schenectady, New York, his home town, joined with General Electric in a three-day observance starting with a radio broadcast which brought back his voice to the ears of thousands, and closing with a testimonial dinner by the American Institute of Electrical Engineers to its past president. Steinmetz's voice was recorded on film in General Electric's laboratories long before the day of the talking movies, and it is this film which was used in the broadcast.

Trees Protected by Lightning Rods

PROTECTION against lightning has been given to a number of fine trees in Maryland, some of them of historic interest, by equipping them with lightning rods. Success with this method over a period of 17 years is described by Dean J. B. Whitehead of the Johns Hopkins University engineering faculty, in a recent issue of *Science.*

The equipment is quite simple. Seven-strand copper cable is led to the top of the tree, its end unbraided to give a number of free discharge points, and the lower end soldered to the top of an iron pipe driven 11 feet into the ground. Some trees have been given several such rods. Several of the trees thus equipped had been struck by lightning one or more times before the installation of the rods, but since then no protected tree has been damaged by lightning, though in some cases other trees nearby have suffered.—*Science Service.*

Artificial Wool from Jute

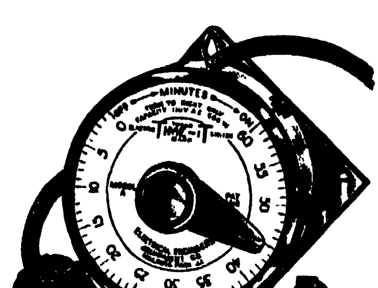
A PROCESS for converting jute into so-called "artificial wool" is reported by *Chemical Industries.* It is stated that brief immersion of the fibers in caustic potash of 25 to 30 percent strength is followed by a drying treatment in a rotating drum. The final product can be woven alone or in mixtures with natural wool, cotton, or silk. —*A. E. B.*

Automatic Timing Switch for Household Use

AN all-electric timing switch which can be used for controlling any ordinary household circuit, such as that for the radio, fan, or lights, as well as heating pads, electric heaters, and so on, has recently been placed on the market by Jones and Lohley, Chicago, Illinois. This timing switch is inexpensive and entirely automatic, requiring only to be plugged into the circuit of any electric device which is to be controlled. Turning the pointer to indicate the time for which the device is to operate is all that is necessary.

"Time-It," as this switch is known, is adjustable for any period from the minimum of 15 seconds to a maximum of one hour. Another model is also available which will turn the power on at any predetermined time and will turn it off again at any later time up to 24 hours.

A device of this nature can be used to cut off appliances automatically after you fall asleep or can be used to extinguish



A new electric timer that can be used to control household circuits

garage lights after you have driven out or after putting the car away for the night. Many other applications will, of course, suggest themselves.

New Glass Passes Light, Blocks Heat

A NEW and remarkable type of window glass that allows light to pass through but refuses passage to heat has been developed by the Corning Glass Works. The new glass, christened Aklo, transmits 70 percent of the visible energy in the sunlight which strikes it, but holds back the heat rays so that barely 30 percent of them pass through. Thus the Aklo window pane brings in the wanted light with a minimum of the summer heat. Energy in summer sunlight is distributed with roughly 44 percent in the visible region, 4 percent in the ultra-violet, and 52 percent in the infra-red or heat rays.—*A. E. B.*

The special grid bottom in this can permits circulation of the salad oil

Aluminum "Tin Cans"

ALUMINUM containers for packing tuna have been introduced by the Point Loma Tuna Packers, Inc. The new can, the result of four years of experimental work, offers a number of advantages over existing types of containers. Made of aluminum, which is non-toxic, the cans have no effect on the taste, color, or other properties of tuna. Furthermore the lightness of the can saves shipping costs, while the non-tarnishing appearance of the containers appeals to dealers. The fact that the cans may be reused for salad molds or oven dishes after their original contents have been exhausted is an item to attract the attention of thrifty housewives.

With many cans there is a tendency for the tuna to settle to the bottom, causing the oil to be forced up around the sides leaving a portion of the tuna dry and tasteless. To eliminate this, a special grid bottom is employed in the aluminum can, which permits free circulation of the salad oil.

Sunlight Is Fatal to Rattlesnakes

ONE ordinarily thinks of a desert rattlesnake as basking in the sun all day long awaiting his prey. Surprisingly, however, direct sunshine quickly kills this cold blooded reptile. This was proved by members of the Yosemite Field School in Yosemite National Park.

A specimen rattlesnake was desired for museum exhibit but in a natural unmutilated condition. Members of the school, therefore, placed a rattler in an exposed position where he died in convulsions under the direct rays of the sun in 17½ minutes. The body, after 18 minutes of exposure, felt warm to the touch.

New Underwater "Telescope"

SPECIAL underwater spectacles that allow lifeguards and divers to see clearly beneath the water's surface have been devised by Robert E. Cornish of the University of California's Institute of Experimental Biology.

The normal human eye, developed for vision in air, is a very poor instrument under water, as every swimmer knows. The reason is that the contact of water with the cornea robs the eye of about two thirds of its refracting power. This trouble is avoided in divers' outfits by keeping water away from the eye and looking through a flat window of glass. If the glass is wet by condensation or splashing it loses its advantages.

Mr. Cornish considered the normal eye under water as an imperfect eye and designed lenses to correct it. He has constructed two such lenses, and finds excellent underwater vision with them, newsprint being read without difficulty with one of them, while without the lenses it is not even possible to see that the page contains printing.

Such lenses promise to have value in saving life, where it is necessary to dive for a victim of drowning. Lifeguards now must grope for the victim and must depend largely on sense of touch. Precious moments thus lost have often resulted fatally for the victim.

One type of lens has the advantage that one can see tolerably well either in water or in air. A more rugged construction however is good only under water and is perhaps best used on one eye only. In clear lakes the wearer may see many yards.—*Science Service.*

Radically New Tubular Lamps

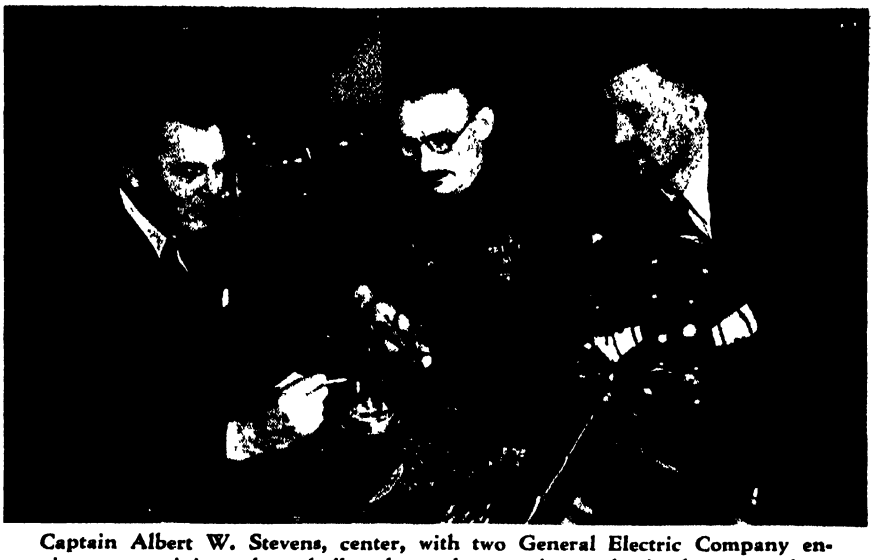
THE development of an unusual line of tubular lamps that can be placed end-to-end to form a continuous sectional line of light in various architectural and other applications has been announced by the Incandescent Lamp Department of General Electric Company at Nela Park, Cleveland.

The new lamps, designated as "Lumiline," incorporate an entirely new technique of sealing a metal base directly to the end of a glass tube without the use of basing cement. Thus, instead of being equipped with a conventional type of base, the new lamps have at each end a special chrome iron contact cap that is sealed directly to the glass tubing. The particular advantage of this construction over the screw base is that by placing the new lamps end-to-end it is possible to achieve a more nearly continuous line of light with a minimum amount of dark area.

The Lumiline lamp employs a single stretched-coil filament drawn out into a continuous line from one end-contact cap to the other. A channel backbone inside the bulb carries the filament along the tube, anchored by wire filament supports attached to the channel backbone and spaced approximately two inches apart.

Lamp Bulbs as Air-Samplers

WHEN Captain Albert W. Stevens, noted United States Army aerial photographer whose photographing of Mt. Shasta, Washington, from a distance of 331 miles made camera history, ascends into the stratosphere in June on a flight sponsored by the National Geographical Society, he will take with him several air-sampling containers designed by General Electric lamp engineers.



Captain Albert W. Stevens, center, with two General Electric Company engineers, examining a large bulb to be used as an air-sampler in the stratosphere

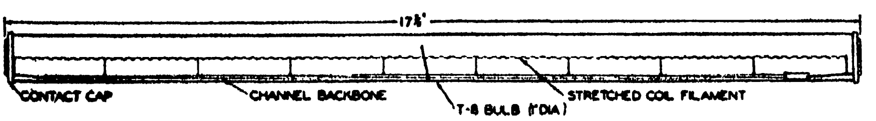
It is Captain Stevens' intention to bring back to earth with him samples of air at various elevations in the stratosphere, and have them subjected to a chemical analysis by the Bureau of Standards.

The air-sampling containers will, it is planned, consist of specially constructed lamp bulbs of the 10-kilowatt size, equipped with valves for the intake and exhaustion of the stratosphere air, and will probably also be equipped with pressure-recording gages.

Insulating Material of "Rubber and Bubbles"

SAID to be the lightest weight solid substance known, Onazote, a patented insulating material made of "rubber and bubbles" is the most perfect insulator against noise and the most resilient of known rubber compounds. This remarkable new material is described by Harry D. Edwards in *Refrigerating Engineering.*

Above: **A new tubular electric lamp, and** ***below,*** **drawing showing how the long filament is braced**



Onazote is made from rubber "dough," of crude or reprocessed rubber with the usual fillers. The dough is partially vulcanized by placing it in a pressure vessel which can be heated externally. Nitrogen gas is admitted until the vessel is filled to a pressure of about 3000 pounds per square inch. Pressure vessel and contents are both heated by steam or other suitable means until a pressure of about 4000 pounds is created. Nitrogen is driven into the pores of the dough and at the same time the expansion of the absorbed nitrogen resulting from the heating causes the dough to expand. In the meanwhile, the application of heat causes a partial vulcanization of dough, so that when it is removed from the pressure vulcanizer it has a consistency of a rubber eraser. Generally, the dough is roughly formed to the shape of the desired article before impregnating and vulcanizing. It is then placed in a mold of the desired form and further heated until completely vulcanized.

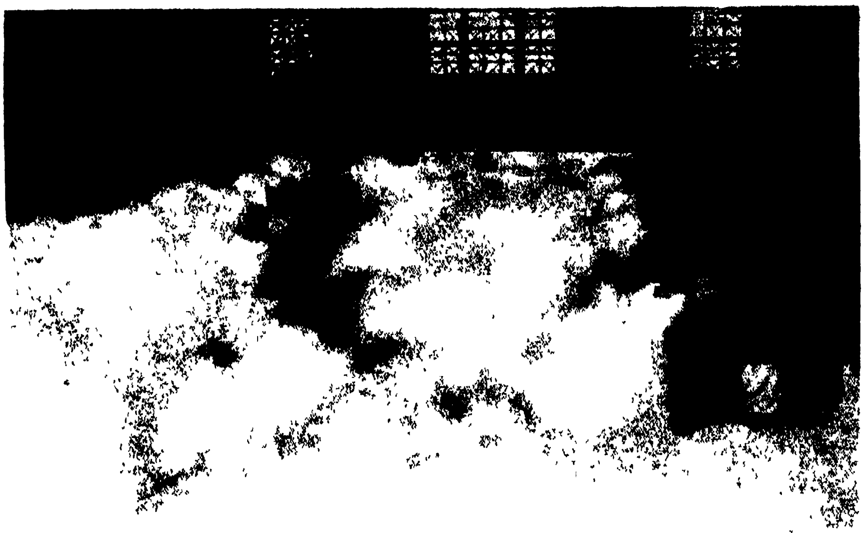
In addition to its excellent insulating properties, Onazote is said to be entirely moisture-proof, of high dielectric strength, vermin proof, and quite inexpensive.—*A. E. B.*

Ravens Know Trick of Military Aviators

STUNTING in the air is not a new thing under the sun. One of the favorite tricks of the military aviator—a quick side roll to an upside down position, followed by a half-loop downward restoring the right side up position and reversing the direction of flight—is known to ravens. Several observations of this turn have been recorded by a German naturalist, J. O. Fulz. —*Science Service.*

The Eugenic Sterilization Movement

THE Japan Race Hygiene Society will soon change its incorporation papers so as to enable it to start a eugenics campaign. Prof. Dr. S. Nagai, its chief, says that the society has decided to present a sterilization bill at the next session of the Diet, which is expected to arouse much discussion. The



Photograph courtesy Federal Laboratories Inc

Clouds of tear gas foil bank robbers without doing permanent injury. When the teller sees indications of criminal intentions, he presses a button which releases the gas. Present-day devices of this sort use chloropicrin, bromacetone, and other similar lachrymators which readily volatilize when heat is applied

bill will go beyond voluntary sterilization in order to rid Japan of unsound hereditary qualities. The details of the bill are kept secret, but diseases incurable even by medicine or punishment are to be governed by this act. As to determining who should be sterilized, an institution is to be established, and in case of opposition an appeal to the judicial court will be allowed. The method of sterilization will be simple and will not be a hindrance to marriage. The whole system will be carefully designed and adjusted to the Japanese nation.—*Journal of the American Medical Association.*

Streamlined Pullman Cars

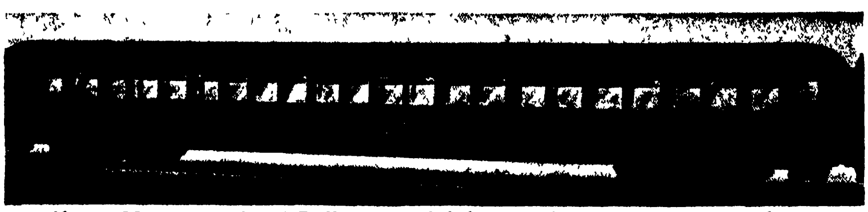
MR. J. J. Pelley, President of the New Haven Railroad, announced recently that the contract for construction of 50 coaches designed for the New Haven by Walter Dorwin Teague has been awarded to the Pullman-Bradley Car Corporation, Worcester, Massachusetts, deliveries to be made in the latter part of 1934.

Details of Mr. Teague's design, which embodies radically new principles, were also made public by Mr. Pelley. The new cars will be operated, so far as possible, as unit trains, but are interchangeable with present equipment if occasion demands. The streamlining of the body and the greatly decreased weight, from 135,000 pounds each with present coaches, to 100,000 pounds with the new ones, marks the first adaptation of modern design to standard railroad coaches and will benefit the railroad principally through reduced fuel consumption.

In order to reduce wind resistance by deflecting air currents, an approach to a tubular cross-section has been effected. Because the cars are air-conditioned the usual clerestory has been eliminated, and a "turtle back" roof adopted. By careful design the over-all height of the cars has been reduced 12 inches without sacrifice of headroom inside. All moldings have been eliminated from the sides and the windows, grouped in pairs, will be framed in a round-cornered polished aluminum band.

The interior has been designed for the maximum of passenger comfort and "eye appeal." Easy riding seats, cleanliness, gaiety of color schemes, ample light, have been the designer's aim. Air-conditioning provides an agreeable atmosphere at all times, as well as a quiet ride, noises being reduced to the minimum.

One of the most important innovations from the point of view of the passenger will be in the seats planned on automotive principles. These seats will be made of metal tubing constructed on the "angle of comfort" principle with detachable cushions and backs and molded arms and will weigh 65 pounds per seat less than the present type. An ingenious pivot arrangement will allow for a foursome of bridge.



***Above:* New streamlined Pullman, and *below,* seating arrangement in the car**

Mining Bromine at Sea

CHESTERTON, in his "Ballad of the White Horse," makes allusion to the towering imagination in the ancient Irish bardic poetry:

"Tales where a man can swallow the sea
That might swallow the Seraphim."

Such a sea-swallowing stunt is at least partly realized, if not by a man then at least by one of man's works, in a new bromine-producing plant established by the Dow Chemical Company at Wilmington, North Carolina.

This plant daily pumps through itself a literal river of salt sea water, drawing it from the ocean and discharging it again into the Cape Fear River. More than a third of a billion pounds of water—175,000 tons, or enough to float all the heavy-gun cruisers in the United States Navy—is sucked in daily by its monster pumps, and comes tumbling out of its discharge gates. What happens to it on the way through explains why this sober industrial chemical company has done such an apparently fantastic thing.

The sea water is made to yield 10,000 pounds of bromine every day, by dumping into it half that quantity of the cheaper element chlorine. The chlorine has a more powerful attraction for the elements that are united with the bromine in the sea water, forces a chemical divorce, and leaves the bromine free to come out of solution, when it is captured, condensed, and prepared for market.

Bromine is a brown substance, which hovers between gaseous and solid states at ordinary temperatures. Vast quantities of it are used in the process of preparing "ethyl-gas" motor fuels, in photography, in medicine and antiseptics, and in many other ways. Although it is present in sea water in such thin dilution that 175,000 tons of the water will yield only five tons of the chemical, the new process of extraction is so simple as to make the plant profitable, though it works what amounts to the lowest-grade "ore" in the world, with the exception of the pitchblende that yields radium, the South African blue clay in which dia-

monds are found, and perhaps one or two other kinds of treasure-containing dross. But bromine is not high-priced like radium or diamonds, so that extraction of this cheap element from vast quantities of water represents all the more a triumph of modern chemical engineering.—*Dr. Frank Thone, Science Service.*

Knife Blade in Brain 15 Years

FOR over 15 years James P. Sherry of Rochester, New York, carried a knife blade in his brain without knowing it.

Recently, severe headaches, and lameness in one leg led him to seek medical aid. Dr. Charles S. Gallaher, of the medical department of the Eastman Kodak Company, where Mr. Sherry is employed, examined the man, detected an abnormal condition of the eye on the side opposite to the lame leg, suspected a brain abscess and took an X-ray picture which showed the knife blade in Mr. Sherry's brain. A fine scar was then found on his scalp. Removal of the blade by surgical operation resulted in the patient's complete recovery.

Strangely enough, Mr. Sherry was not only ignorant of the blade's being in his brain, but did not even remember ever suffering a head injury. The only possible explanation is that the blade entered his brain at the time of a war injury. Mr. Sherry was struck on the elbow by shrapnel in the Argonne. For hours afterward he was dazed. Mr. Sherry and his medical attendants believe that the knife blade was in the same shell and was driven through the skull by the same burst, probably going in red hot and cauterizing the wound it made. It is understood that the Germans, short of materials toward the end of the war, used odd scrap metal for shrapnel, which would explain how the knife came to be in the shell. —*Science Service.*

Attempts to Accelerate Aging of Liquor

ONE needs only to glance over the whiskey advertisements to realize that the question of proper "aging" for liquor is one which is a vital factor to the distillers. The sudden repeal of prohibition created a demand for good whiskey that could not be met by available stocks. So the burning question with the producers today is: "How can we speed up the 'aging' process?" Foster D. Snell and J. Mitchell Fain, consulting chemists, discussed four known methods of accelerating aging at the recent meeting of the American Chemical Society.

"During the aging process," said Mr Snell, "the constituents of alcoholic spirits undergo chemical change. A study of the changes taking place in whiskey stored in wood over a period of eight years revealed important relations between the acid, ester, color, and solid content of a properly aged whiskey. In the aging process the acids at first form more rapidly than the esters. Later the esters form more rapidly, so that by the end of the fourth year they are present in the same amounts as are the acids. The amounts of higher alcohols increase in the matured whiskey only in proportion to the alcoholic concentration.

"The deceptive, and to some pleasant, slightly oily appearance of a matured whiskey is due to material extracted from the charred container, and this appearance is of course lacking in whiskies which have been aged in uncharred wood. The improvement in flavor of whiskies in charred containers after the fourth year is attributable largely to concentration rather than to the formation of new components.

"All research so far in this direction may be resolved into four categories. In the first, the liquor is treated with air, oxygen, or ozone, by a variety of processes suggestive of the carbonization of soda water, but using oxygen or ozone instead of carbon dioxide.

"The second method involves exposure to actinic rays which have been found to possess special virtue as aids in accelerating the aging of liquor. Thus in the aging of wines and liquors by the action of ultraviolet light, the liquor is passed over a vapor electric arc housed in quartz.

"The third principal classification involves electrolytic treatments, comparable to electrolysis of water. The passage of an electric current through beverages, as in the case of water, produces a quantity of both hydrogen and oxygen. Sometimes electrolysis is effected in the presence of the substance which the spirits on long standing will extract from oak wood.

"The fourth method involves the use of catalysts. A catalyst is a material which is present during the course of a chemical reaction, and which may change the speed or effect of the reaction without itself being engaged. Among the catalysts used are finely dispersed metal oxides, such as copper, nickel, and titanium.

"There are many other methods which cannot be classified and of which some, I believe, may be valuable to particular distillers, depending upon the individual factors inherent in their plant and equipment."

Although it is entirely likely that one or more of these processes may be developed to a point where artificially aged liquor will be as good or better than "real eight-year old stuff," chemists generally admit that there is still a lot they do not understand about the chemistry of aging and that to date, they can not claim to do the job as well as Old Father Time does it. —*A. E. B.*

A simple bath cap of Cellophane protects the hair in the shower

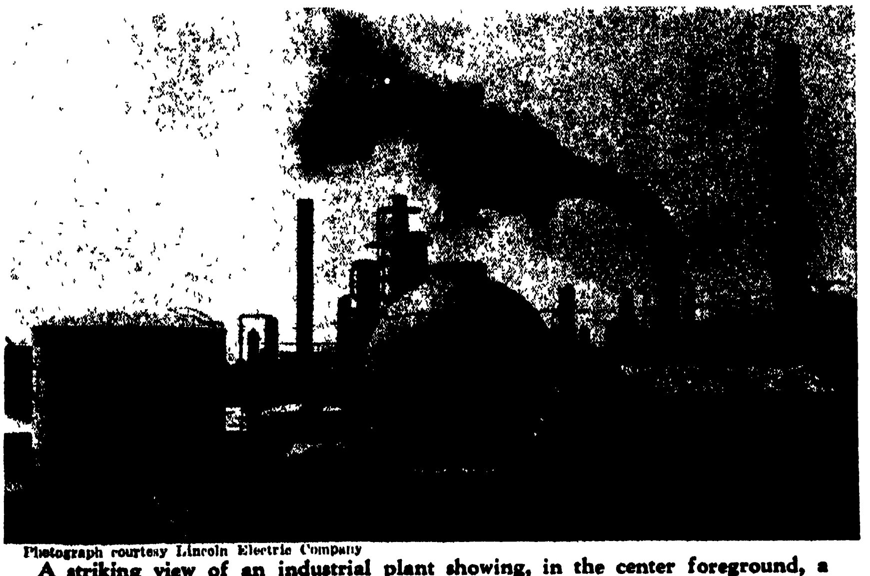
Watermelon Snow

THE southern darkie, with his proverbial fondness for watermelon, would no doubt revel in the snow in a drift high on Lassen Peak in California—for this snow not only is watermelon pink, but smells and tastes like watermelon. This peculiar condition has a simple scientific explanation. The color, smell, and taste are due to a minute plant of the algae family which is present in enormous quantities. Its scientific name is *Protococcus nivalis.*

Premature Babies Have Normal Mental Development

THE mental development of babies born prematurely, sometimes called "midget" babies because of their small size at birth, goes along at the same rate as in their brothers and sisters who were born at full term. Evidence of this was obtained in a study reported by Dr. George J. Mohr of the Pittsburgh Child Guidance Center and Dr. Phyllis Bartelme of the Chicago Institute for Juvenile Research at a meeting of the American Orthopsychiatric Association.

Two hundred and fifty prematurely born white children were studied and compared with 150 of their brothers and sisters who



Photograph courtesy Lincoln Electric Company

A striking view of an industrial plant showing, in the center foreground, a Hortonspheroid gas container composed of plates welded by the electric arc

Courtesy Aluminum Company of America

In this room the walls are covered with horizontal sheets of aluminum. The mouldings, baseboard, and trim were left in natural color, the rest of the walls being done in a rich reddish brown. The curtains are made of aluminum mesh

had been born at term. Both physical and mental growth were studied. The brain and nervous system were apparently not affected by premature birth, but heart, blood vessels, and digestive system were found seriously affected. Such changes as were found in the brain and nerves were the result of weaknesses of the heart and blood vessels.

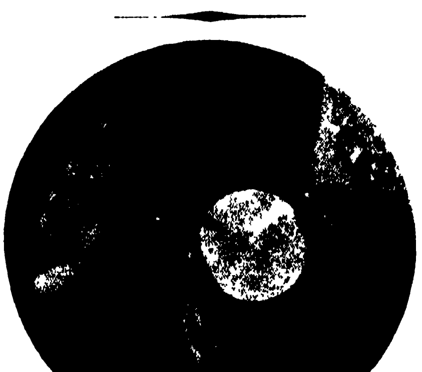
Weight of the babies at birth apparently had nothing to do with their mental development, although it was a factor in their physical development, particularly among the boys.—*Science Service.*

Scientific American History

WE are so often asked for an outline of the history of SCIENTIFIC AMERICAN that we believe it would be appropriate to reprint from the 13th volume of the Dictionary of American Biography, the brief biography of the present editor's grandfather who built the magazine into an American tradition. This gives the essential facts.

MUNN, ORSON DESAIX (June 11, 1824–Feb. 28, 1907), editor, publisher, was the youngest son of Rice and Lavinia (Shaw) Munn and was born in Monson, Mass., where his father was engaged in business. His first direct American ancestor was Benjamin Munn who in 1649 removed from Hartford, Conn., and settled in Springfield, Mass. Orson was educated at Monson Academy, and, having decided upon a commercial career, began work at the age of nineteen as a clerk in a bookstore in Springfield, Mass. After two years he became a clerk in a general store in Monson and was so engaged when, in 1846, he was asked by his friend and schoolmate, Alfred E. Beach [*q.v.*], to join him in the purchase of a publication called the *Scientific American*, which had been founded Aug. 28, 1845, by Rufus Porter [*q.v.*]. Munn accepted, the firm of Munn & Company, consisting of Beach, Munn, and Salem H. Wales, was established, and office space was secured in New York in the building occupied by the New York *Sun*, a paper then owned by Beach's father.

The first issue of the *Scientific American* under the new firm appeared July 23, 1846, and from that time until his death, sixty-one years later, Munn gave his whole attention to its interests. Inasmuch as it was the first American periodical devoted purely to science and mechanics, the partners were constantly brought into contact with inventors seeking information and advice regarding patents. Consequently, they established a patent department, which, coming at a time when patent attorneys were practically unknown, met with immediate response. Under the directorship of Judge Charles Mason [*q.v.*], a former commissioner of patents, the business grew at a rapid rate, necessitating the opening of an office in Washington, D. C., and at the time of Munn's death over 100,000 patents had been secured by the department for clients. Properly to describe and illustrate the interesting exhibits at the Centennial Exhibition of 1876, the partners began in that year the publication of the *Scientific American Supplement*. Its success led them to continue it as a weekly review of current scientific literature and to add also articles too long or too technical for the ordinary reader. About 1890 they began still another publication, *La América científica e industrial*, designed for the Spanish-speaking peoples of South America. One of the features of the *Scientific American* was its information bureau; and in view of the many requests for data on home building and furnishing, Munn began in 1885 the publication of a monthly magazine devoted to this subject. It appeared for a time as the Building Edition of the *Scientific American*, but in 1905 it was remodeled and issued under the name *American Homes and Gardens*. Aside from his business, Munn's chief interest centered in his farm near Orange, N. J., and in his prize stock of Dutch belted cattle. He married Julia Augusta Allen of Monson, Mass., in 1849, and at the time of his death was survived by a son.

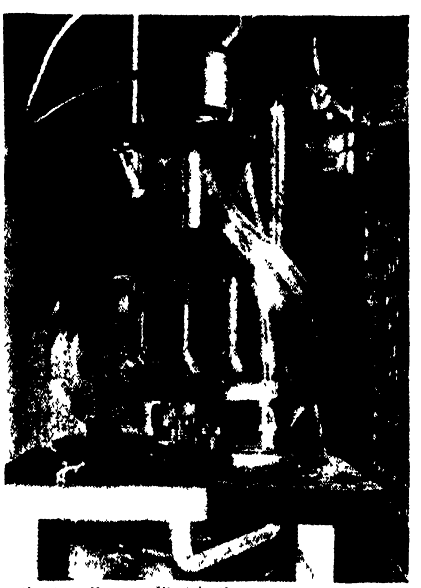


From Gummy Nuisance to Useful Plastic

THE sticky, resinous gum, which has plagued the producers of cracked petroleum gasolines by gumming up stills and condensers is now being converted into a useful product, a new synthetic resin. Instead of trying to eliminate the gum, the job now is to get more of it! This new type of synthetic resin, useful for varnish and for molded articles, is being made by the catalysis of petroleum hydrocarbons, according to A. D. Camp, writing in a recent issue of *Chemical and Metallurgical Engineering*. It is a hard, brittle material, having a melting point of 110-115 degrees, Centigrade. It is soluble in practically all hydrocarbon solvents, and insoluble in methanol, ethyl alcohol, and acetone. The resin is readily soluble in drying oils such as linseed and china-wood oil, and with the latter it makes varnishes which dry more rapidly than those made with any type of resin heretofore known.

In the molded plastics field, petroleum resins have been used to some extent by compounding them with certain fillers and plasticizers. They have been used for the fabrication of steering wheels, tool handles, electrical fixtures and many articles to which molding resin mixtures are now being applied.

The process of manufacture of petroleum resins consists in treating a cracked distillate containing hydrocarbons such as olefines and diolefines in the presence of a metallic halide catalyst under carefully controlled conditions. By modifying the conditions of treatment, the properties of the resultant resins can be varied widely.—*A. E. B.*



Courtesy Western Electric Company

High-quality granular carbon type telephone transmitter diaphragms are now made of duralumin with the electrode area in the center covered with a thin gold coating deposited by cathodic sputtering. The vacuum chamber in which the sputtering is done is shown *above*, and one of the diaphragms with the gold center applied is illustrated in the circle at the *left*

Frozen Milk

H. A. HARDING, Ph.D., chief of the Dairy Research Bureau, The Mathews Company, Detroit, has called attention to interesting and striking experiments made by Paul W. Emerson, M.D., instructor in pediatrics, Harvard Medical School, the results of which tend to controvert the theory that freezing has a deleterious effect on the physical properties and nutritional value of milk. Doctor Emerson's studies showed that

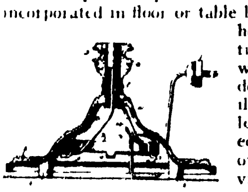
(*Please turn to page* 323)

RECENTLY PATENTED INVENTIONS

Conducted by A. P. PECK

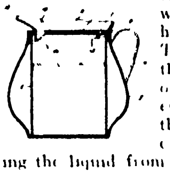
Lamp Cord Retaining Device

Patent No 1917517 Louis Brosilow, William Markoff and John Orosz In order to provide for a simple and practical device which may be incorporated in floor or table lamps to receive and hold the unused portion of the attached wire or cord, the device shown in the illustration at the left has been patented Within the base of the lamp is provided a reel for receiving and holding the cord, so that only enough need be withdrawn to connect the lamp to the nearest electric outlet



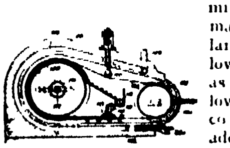
Pitcher for Using Cans of Milk

Patent Number 1918997 Vincent Vareck and Joseph Heline Cans of evaporated milk or other liquids can be easily used in this invention which provides a pitcher-like container for such cans In use, the can is placed within the container and the hinged top is forced down Two sharp projections within the lid punch holes into the top of the can and provide for the escape of the liquid as well as the entrance of air Thus the can is held securely and pouring the liquid from it is made more convenient



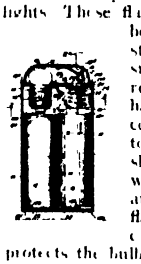
Briquettes

Patent No 1948471 Henry O Loebell and Albert I Klees This newly invented process for preparing carbonized fuel briquettes concerns the high-speed production of uniform briquettes from mixtures of carbonaceous materials and particularly those of relatively low volatile content, such as anthracite coal and low volatile bituminous coal, to which have been added suitable binders such as various tars and pitches In our reproduction herewith is illustrated a device for producing these briquettes in quantity using final carbonization temperatures of 1200 to 1800 degrees Fahrenheit.



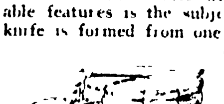
Flash Light

Patent Number 1948613 Otto C Britsch This patent pertains to simple portable lighting devices and particularly to pocket battery flash lights These flash lights are so designed as to be rugged in construction to withstand hard usage and still are small and compact enough to be readily carried in the pocket or handbag They are furthermore convenient to handle and simple to manufacture In the type shown, a lid covers the bulb, when the lid is raised a switch is automatically operated Two small flash light cells are held in the case When the lid is closed it protects the bulb from breakage



Cake Knife

Patent No 1948592 William L Nelson A newly devised cake knife which has several desirable features is the subject of this patent The knife is formed from one sheet of metal and is cut and bent so that it takes the shape shown A piece of cake can be cut with the long blade of the knife and then removed by sliding the blade under the piece, at which time two prongs are forced into the back of the slice, thereby making it possible to remove the slice without the usual balancing effort being required The forked part of the handle may be slightly compressed so as to hold the cake firmly and to facilitate removal



Preserving Proof of Invention

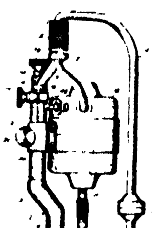
EVERY inventor who is working on a device which he contemplates patenting should first prepare sketches and a description of his invention, which should be dated and witnessed by at least two persons. The inventor has thus established the date of his disclosure, and such evidence should be deposited in a safe place from which it may be produced when needed.

When an invention has been completed, it is advisable to file an application for patent without delay. However, we realize that many inventors today do not have sufficient funds to meet this expense, nor have they safe places in which to keep their disclosures. Therefore *Scientific American* will undertake to act as a depository for such documents These will be held in safekeeping for two years (unless withdrawn by the depositors) and then destroyed without opening.

To take advantage of this offer, place your papers in a sealed envelope endorsed with your name and address and marked "Not to be opened." Then enclose this in another envelope addressed to A. P. Peck, Associate Editor, Scientific American, 24 West 40th St., New York, N. Y., and mail. *—The Editor.*

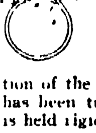
Valve Seat Grinder

Patent No 1918792 Clifford C Lee Grinding the valve seats in internal combustion engines is always a problem This patent describes a method whereby these seats may be ground accurately and rapidly by means of rotating grinding points operated by an electric motor By the provision of a suitable upright, which supports the motor, the grinding element is always situated in the proper position for producing the correct angle on the valve seat face A series of adjustments permit changing the position of the various parts so that valve openings of different sizes may be worked upon with a minimum of effort The vertical support for the motor is inserted in the valve guide and as the grinding point is turned it describes a true circle around this center



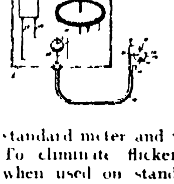
Hose Clamp

Patent No 1917715. Lawrence H. Hener This newly invented hose clamp has a body made entirely of wire, shaped by means of bending operations The part which engages the clamping screw is formed in a spiral of the same pitch as the thread of the screw The part which engages the head of the screw is of such size as to allow the screw to pass through it This eye is so arranged by a bending operation as to resist the frictional turning action of the screw head. When the clamping screw has been turned into position, the whole device is held rigidly around the hose.



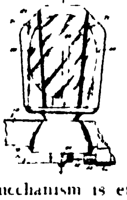
Portable Stroboscope

Patent Number 1948740 Douglass A Young. For testing electric meters, it is desirable to determine the exact speed of the meter disk and thus compare the speed with that of the disk of a standard meter The object of this invention is to provide portable apparatus which will do this work, in which a grid-glow tube is caused to give off intermittent flashes of light in accordance with the speed of the standard meter disk, whereby stroboscopic comparisons may be made of the speed of the disk of the standard meter and that of the meter under test To eliminate flickering of the grid-glow tube when used on standard low-frequency voltages, a high frequency voltage from a special source is impressed on the tube



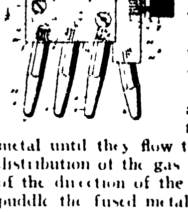
Headlight Construction

Patent No 1918261 Martin R Hoag. This patent pertains to headlights for automobiles and the like, said lights to be so arranged that the reflector turns as the vehicle is steered and thus illuminates the road directly ahead regardless of the angle through which the vehicle may be turning In this particular type of headlight, which employs a tubular bulb, it is claimed that a relatively bright beam of light is projected directly in front of the automobile with an area of diffused illumination on each side A relatively simple mechanism is employed to connect the movable reflectors with the steering gear on the automobile or other vehicle



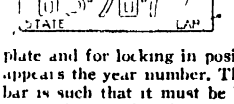
Multiple Flame Welding Nozzle

Patent No 1917755 Worthy C Bucknam and George I Jones In this new welding nozzle, one form of which is shown in the accompanying drawing provision is made for gas distributing and fluid cooling passages within and also for controlling the direction of pre-heating and welding flames In operation, the flames from some of the tips are directed upon the metal to be welded so as to pre-heat it up to or slightly below the point of fusion Immediately thereafter a flame from another tip fuses the edges of the metal until they flow together and unite Proper distribution of the gas to the nozzles, and control of the direction of the flame, make it possible to puddle the fused metal properly, yet not burn it or blow it out of the seam being welded.



License Plate Lock Bar

Patent No 1918554 Harrison Graham Williams. This invention presupposes a change in the conventional system of license plates for vehicles as now used It provides for a permanent number with a re-issue each year of only a small plate on which the year is stamped The invention provides for a method of supporting a permanent plate and for locking in position the bar on which appears the year number. The construction of this bar is such that it must be broken in order to be removed and, therefore, a new bar must be obtained before the vehicle may be used.



The above information has been taken from copies of patent specifications No further details are available except as can be obtained from such specifications.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 320)

premature babies, who are much less vigorous and therefore more easily affected by changed conditions than normal infants, not only accepted and digested frozen human milk as well as they did fresh human milk but gained approximately as much as babies fed the fresh milk. The age of the frozen milk varied from one to 220 days. In the light of these observations it would apear that a single freezing for a few hours which normally takes place in connection with the delivery of bottle milk would be without effect.—*Health News* (publication of the New York State Department of Health).

Furfural

FURFURAL is not a new chemical but, industrially, it has a story which is new. It was discovered 103 years ago and its name, derived from the word equivalents for bran and oil, is more than 90 years old. It is not made commercially from corn cobs, as some people suppose. By the world's largest manufacturer of rolled oats it is made from oat hulls. Some investigators believe that during the next 50 years furan chemistry will occupy a position analogous to that of benzene chemistry during the past 50 years. Fifteen years ago an order for five pounds could not have been filled within six months. Today 10,000 gallon shipments are of common occurrence. Because of its exceptional solvent power, furfural is used in diversified fields—varnish removers, shoe dyes, textile printing, resin impregnation. In the oil industry it facilitates obtaining extremely high quality lubricating oil, in good yields, from a wide variety of stocks.

Why Vehicles Pass on Right

THE Conestoga wagon, the freight-hauling vehicle of American pioneer days, is responsible for the present custom of vehicles passing on the right in the United States, according to the Bureau of Public Roads. Before the extensive use of the Conestoga wagon it was the custom to pass vehicles to the left, following the earlier English rule.

In England, in the days when men traveled armed on horseback, it was the custom to pass to the left so that the sword or pistol arm would be on the side of the man passed. Later, in travel by coach or wagon, the driver sat on the right side to give his right arm free play in wielding the whip, and passing to the left he was better able to avoid entanglements with the wheels of passing vehicles. Traffic passes to the left to this day in England.

On the Continent—in France, Germany, and Italy—the postillion system of driving, by which the driver sat on the left wheel horse, existed in the early days for both coaches and wagons. To a man riding the left wheel horse passing to the right gives a better view of the passing vehicle. In these countries, passing to the right has always been the custom.

In Italy, until the time of Mussolini,

• (*Please turn to page* 326)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

TELESCOPE making is distinctly not a hobby for small boys, since the worker should have had at least two years in high school, but now and then some bright, enterprising lad crashes through in spite of odds, proving that he has "the stuff" in him, and for such lads there is a welcome. In a letter Russell W. Porter relates how Oscar Marshall, a charter member of the Telescope Makers of Springfield, Vermont, who removed to Pasadena to do fine optical machine work for the California Institute of Technology, ran across one lad who deserved attention and received it.

"The spread of amateur telescope making is a constant source of wonder to me," Mr. Porter writes. "Only last week I spent a delightful afternoon with a prominent movie star in Hollywood, who had made his six-inch telescope and is planning a ten. But the biggest kick came yesterday. Marshall saw a boy over a fence working on something that had the earmarks of a reflector. He stopped his car and came over to the fence.

"'What you got there, boy?'

"'Telescope.'

"'May I have a look?'

"'Sure, but she doesn't work very good. I can see all right but there are a whole lot of images.'

"Marshall looked down the tube.

"'Did you make the mirror?'

"'Oh no, it's a shaving mirror I bought at the five-and-ten for 25 cents.'

"'And the diagonal?'

"'That's a piece of looking glass.'

"He had taken the eyepiece from a small spyglass, and the whole affair was in a pasteboard tube swung in a wooden fork that rose from the three legs of his mother's Christmas tree stand.

"Well, Marshall put him wise to the extra images and today we went up and photographed this young Richard Cale, aged 13, with his instrument. He had found a looking glass man who had silvered his mirror and ready-made diagonal, and in his hands was a copy of 'Amateur Telescope Making.'

Porter and Cale, Inc.

A look through the eyepiece at some distant clapboards and I could well appreciate the enthusiasm that shone in the boy's eyes.

"'Now,' he said, 'I'm going to make a real telescope.'

"'Fine,' I replied, 'and tomorrow after school, come down to Cal. Tech. and I'll show you how we are trying to make a real telescope' (meaning the 200-inch).

"'Oh gee, will you?'"

So this lad whom Porter took in tow probably saw more about the 200-inch telescope than most of us have seen—which is mighty little more than nothing at all. "I never saw Porter more enthused," Marshall writes, "than when he inspected the lad's enterprise." The photograph was taken by Marshall, who is a sort of amateur professional photographer, or a professional amateur.

CALIFORNIA is still making plenty of telescopes. From the Telescope Class, Franklin High School, Los Angeles, comes the wide photograph reproduced below, and the following comment:

"Los Angeles Public Schools now have a class in telescope making. There are about 40 pupils in the class, which meets at the Franklin Evening High School twice a week. All of the pupils intend to make complete telescopes, although at the present writing most of them are still working on their mirrors, which range in size from four to twelve inches. 'Amateur Telescope Making' is being used as the textbook with great success. Rex W. Beach of Los Angeles is the instructor.

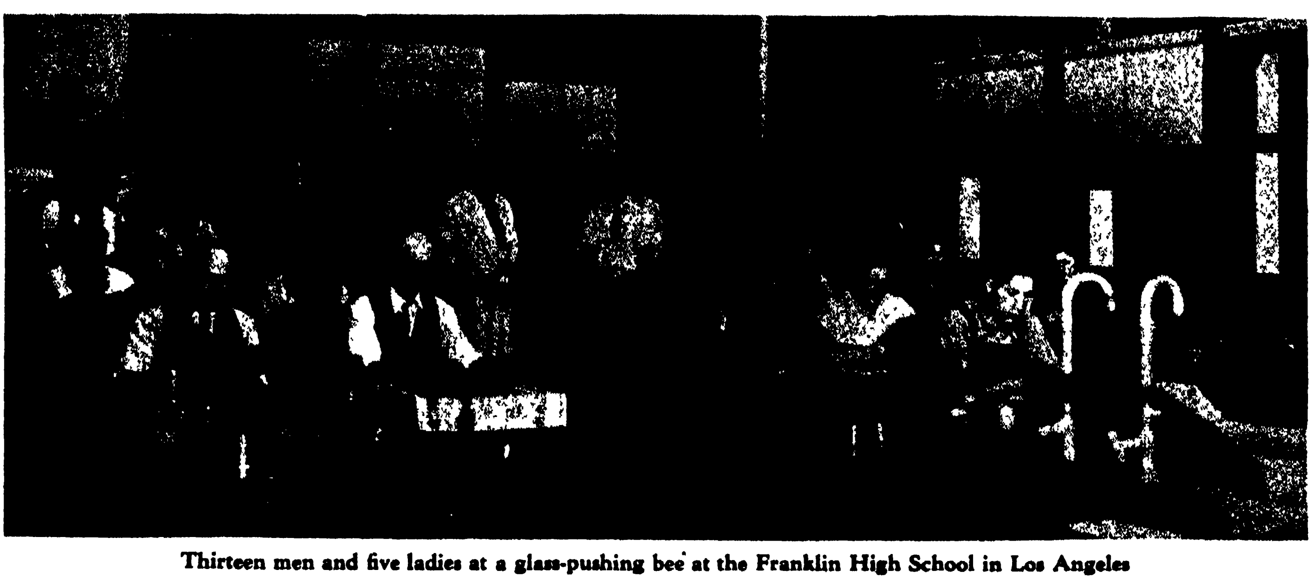
"The class was organized in February under the Federal Emergency Educational Program. A class of this kind constitutes a novel addition to the regular school curriculum and it is hoped that it can be made a permanent thing. A chemistry laboratory room was found to be ideal for making telescope mirrors. Telescope building is a large subject which can offer many worthwhile projects for other classes. For example, a good mounting can be made in either the woodshop class or in the metal-shop class, the mirror can be silvered in the chemistry class, and the mathematical locations of celestial objects can be worked out in the mathematics or astronomy classes."

A METHOD for lining up the optical parts of a Newtonian telescope, suggested by J. V. McAdam of Hastings-on-Hudson, N. Y., runs as follows:

"*A*, *B* and *C* are cardboard disks with 1/4" holes at center, covered with tinfoil having 1/8" holes at center.

"*D* is a tube 8" long—cross hairs at one end, head in other end, with 1/32" hole. Head lined with white cardboard having 1/8" central hole. Window in side of *D* to illuminate cardboard.

"Remove prism and mirror. Line *C* up



Thirteen men and five ladies at a glass-pushing bee at the Franklin High School in Los Angeles

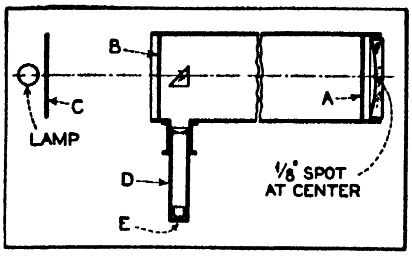
with *A* and *B* at about center of curvature of mirror, by sighting through *A*.

"Remove *A* and *B* and insert prism, mirror, and *D*.

"Adjust mirror to cast image on *C*, concentric with pinhole. This brings axis of mirror absolutely to axis of tube.

"Adjust prism to bring spot in center of mirror, cross hairs in *D* and image of *E* reflected from face of prism exactly coincident. This brings faces of prism square to mirror axis and ocular axis and insures rays converging on ocular being symmetrical about ocular axis.

"All parts should be securely clamped into position to prevent movement during adjustment."



McAdam's method of lining up

EVERY summer an informal convention of amateur telescope makers is held at the fountainhead of the telescope making hobby, Stellafane, near Springfield, Vermont, and A. D. Baker, Secretary of the Telescope Makers of Springfield, states that this year's meeting will be held on Saturday, July 21. Any reader not already familiar with these annual hob-nob gatherings is advised to throw his telescope into his car, leave his Sunday clothes at home, and come—or to come empty-handed. Don't await an engraved invitation—you won't receive one. An interest in telescopes and in other astronomically minded amateurs will be quite enough. Generally about 200 hobbyists attend these meetings.

BOSTON has organized a club called the Amateur Telescope Makers of Boston. Wagn H. Hargbol of 600 Beech St., Roslindale, Massachusetts, is the president, and Miss Thelma Johnson, 11 Brogan Road, Medford, Massachusetts (who has made a telescope) is the secretary. About 30 attended the first meeting.

Amateurs who would like to discuss clubbing together to have a batch of 16 or 20-inch mirror disks poured, and thus get a lower price if possible, are requested to write, not to us, but to Richard Perkin, 122 Chester Ave., Garden City, New York. If a dozen or so decide on uniform orders it is thought that the price per disk will be greatly reduced. Various workers who have tried to make laminated disks, in order in that way to obtain disks larger than the available stock sizes, have recently reported bad results. The disks seem for a time to hold up, and then slump. Alan R. Kirkham of Tacoma now reports the same experience, and suggests putting a large question mark opposite his note on page 308 of "Amateur Telescope Making." Your scribe takes the blame for the insertion of this note, for it was he who inveigled Kirkham into writing it—partly against the latter's own judgment. In England, however, Messrs. Hindle and Steavenson (see cut, "A.T.M.," page 453) are endeavoring to whip this problem.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 323)

vehicles in the cities, where postillions were customary, passed to the right; in the country, where box wagons were much used, vehicles passed to the left. Mussolini made passing custom uniform by decreeing that all should pass to the right.

The drivers of the Conestoga wagons rode the left wheel horse. Passing to the right was more convenient in spite of the fact that it was the custom to pass to the left, as in England. Drivers riding the "lazy board" of the Conestoga wagon—a board between the two left-side wheels that pulled out and could be ridden when driving from the side of the wagon—preferred passing traffic to the right.

The deep wagon ruts in the single-track roads made by the Conestoga wagon drivers were followed by other traffic. This explains why vehicles pass to the right in the United States.

Cork Paint

PAINTS containing powdered cork are said to be effective in several novel applications because of cork's natural resistance to rust and corrosion and its insulating value against heat, cold, moisture, and sound. Cork itself is elastic, ductile, and impenetrable to gases and liquids at normal and elevated pressures.

Cork paints, according to *Solvent News*, applied to the under side of automobile hoods are said to protect the finish on the outside from the heat of the motor. On the surfaces of airplane cabins, they are said to provide a certain amount of insulation against motor noise.

In the production of cork paints, dry cork meal is mixed with paints containing pigments such as ochre, chromium, oxide green, and so on, but the mixtures are not ground together. Cork paints may be economically applied only by spraying, pressing, or rolling. Application of a number of thin cork paint films is preferred to a single thick coat.—*A. E. B.*

Radium Dial Painting Still a Hazard

RADIUM dial painting still threatens the health of the workers in the industry, it appears from the report to Congress of Surgeon General Hugh S. Cumming, United States Public Health Service.

The health hazard of this occupation was not entirely eliminated when the habit of pointing the radium paint brushes with the mouth was eliminated, Dr. R. R. Sayers and associates of the federal health service found on investigation during the past year. Their examinations showed that there is a slight accumulation of radium in the bodies of workers who have been employed since January 1, 1927; that is, under present conditions with mouth pointing eliminated. It was this habit of pointing the brushes in the mouth that was held responsible for the tragic deaths by radium poisoning that occurred during the early days of radium watch dial manufacture.

Dust in the air of the workrooms was

found by Dr. Sayers and associates to be radioactive to a degree sufficient to account for the radium accumulation in the bodies of the employees.

The federal health experts recommend that dust in the workrooms should be prevented by extreme cleanliness in the factory, in other words by "good housekeeping." In addition, personal cleanliness of employees and adequate ventilation, both local and general, were urged.—*Science Service.*

Phosphorus Deadly to Waterfowl

PLANS are under way for removing a menace to waterfowl in the large quantities of phosphorus that have been lying on the bottom of waters contiguous to the Aberdeen Proving Ground at the head of Chesapeake Bay in Maryland The poison menace has resulted in the death of thousands of ducks in the last 10 years, according to Paul G. Redington, Chief of the Bureau of Biological Survey. The canvasback, which is perhaps the most highly prized of all waterfowl and a species that has been reduced seriously in recent years, has suffered from the poison more than other varieties of game birds Bombing tests conducted by the War Department 10 years ago scattered the deadly chemical under water over 10 or 12 acres of the feeding ground of the birds.

The removal of the phosphorus will be accomplished as a result of dredging operations made necessary in the extension of the air field at the Proving Ground. Announcement of the approval of the project will be a source of gratification to sportsmen and conservationists, as the menace of phosphorus poisoning will now be removed from the waterfowl using this favorite feeding and resting ground. These birds are protected by international treaty, as most of them breed in Canada and winter in the United States.

Something New in Air Conditioning

A NEW air-conditioning system, operating 12 months of the year, in cold weather burns either gas or "coal sticks" wrapped in paper. Each stick weighs about 20 pounds and is 20 inches high and six inches in diameter—not too heavy for a woman or boy to handle.

Inserting the "coal sticks" in the new air-conditioning unit described

The equipment provides complete air conditioning throughout the year. It will heat, humidify, and clean the air in the winter time. It will de-humidify, clean the air, and cool it in the summer time. It is entirely automatic in burning either coal or gas.

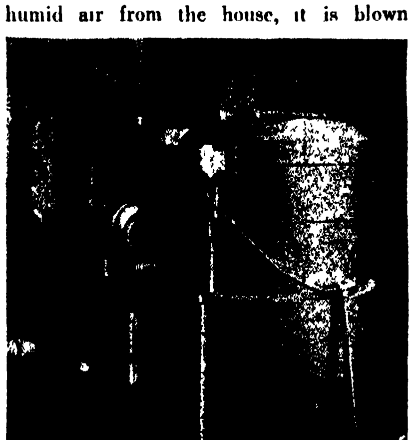
The design of "Conditionedaire," as the equipment is called, is generally rectangular as to base, but rounded on both ends. On one end is a circular heat exchanger that rises above the base. The other end provides a circular magazine rising above the base. This magazine is similar to a revolver with a cylinder containing six chambers. This is enclosed in an air-tight cylinder of Armco sheet iron. A door is provided so that the magazine can be loaded with six sticks of coal. One additional stick is in the fire pot, making a total of seven sticks. These sticks are fed automatically as required into the fire pot, which is about 8 inches in diameter. The coal is burned under forced draught provided by a small combustion blower on the top of the base. The motor which operates the blower is provided with a reduction gear that agitates the grate at sufficient intervals to keep it clear of all ashes and clinkers.

The same motor also turns the magazine around whenever a new stick of coal is necessary. The mechanism to accomplish this is quite simple. As a coal stick is consumed, it drops farther and farther into the furnace. At last it engages a contact which automatically makes an electrical connection that connects the running gears with the magazine and turns it around. When the new stick is brought over the hole where it is fed into the furnace, it disengages the contact.

In the winter time the equipment first cleanses the air. A blower which circulates warm air through the house is of sufficient volume to change the air twice an hour in an eight room house, and the air is cleaned with each operation. Then it is heated up to 200 degrees. Also, it is humidified to the proper comfort zone.

In the humidifier a small jet of heated water is provided in the outgoing hot air flow and this water is broken up and vaporized. Thus the atmosphere is quickly humidified to the proper comfort zone.

In the summer time the same equipment is used to cool and de-humidify the air. As the fan exhausts the warm and humid air from the house, it is blown



Rear view of the air-conditioning equipment; motor is at left center

through and around metal cones which are kept continuously cool by sprays of cool water. The relative humidity is materially reduced which, added to the stirring of air, produces the pleasant comfort zone.

Vitamin D Milk and the Teeth

No more important contribution to public health has been made in recent years than the development of vitamin D milk, writes Dr. James A. Tobey in a recent issue of *Dental Survey*. Vitamin D milk is particularly valuable as a dietary measure to promote strong well-formed teeth, since it supplies both the calcium and phosphorus needed by the skeletal structure, and the vitamin D which acts to cause these minerals to deposit in the bones and teeth.

The accepted methods for enriching milk in the antirachitic vitamin D are by means of irradiation of the fluid milk with carbon arc lamps, or the feeding of the cattle with irradiated yeast. A pint and a half of milk so treated is equivalent in physiological action to three teaspoons of a standard cod-liver oil, and will prevent and cure rickets in young infants.

Irradiated and pasteurized vitamin D milk and certified vitamin D milk, the latter from yeast-fed cows, are now available in several hundred cities in the United States, including New York, Boston, Philadelphia, Detroit, Milwaukee, and Bridgeport, and these milks are rapidly being introduced in many other communities.

CURRENT BULLETIN BRIEFS

"Thermit Welding—Industry's Master Maintenance Tool." This new booklet describes the Thermit welding and alumino-thermic process which has been successfully employed for more than 30 years in the welding of heavy sections of ferrous metals. The actual welding of railroad track and the repair of large machine parts, huge machine castings, crankshafts, and similar articles are also covered thoroughly. Particular attention is given to the economy and permanency of the repairs, and actual cost data are given in a number of instances. *Metal and Thermit Corporation, 120 Broadway, N. Y.—Gratis.*

Hays Combustion Recorders. (Catalogue R A-34). This pamphlet deals with combustion meters for carbon dioxide only and for carbon dioxide combined with records of overfire draft and flue gas temperature. The subject is clearly explained in the pamphlet which is of interest to all those who operate boilers. *The Hays Corporation, Michigan City, Ind.—Gratis.*

Science in Buying. *A Series of Eleven Radio Talks.* These broadcasts were mostly by Fellows of the Mellon Institute, and were given by the Kaufman Research Foundation. The broadcasts treated important phases of merchandising. *The Mellon Institute, Pittsburgh, Pa.—Gratis.*

Crystalline Structure in Relation to Failure of Metals Especially by Fatigue, by Dr. H. J. Gough, F.R.S., Super-

intendent of the Engineering Department, National Physical Laboratory, England, who has carried on extensive experimental studies of metallic single crystals. The failure of metals in relation to the crystalline structure forms a subject of mutual interest to the chemist, engineer, metallurgist, and physicist. A considerable portion of the lecture, which in its published form aggregates 110 pages, is devoted to a thorough discussion of failure under repeated cycles of stress or "fatigue" in relation to the crystalline structure. *American Society for Testing Materials, Philadelphia, Pa., 1315 Spruce Street. Price $1.00*

THE NORTON PULPSTONE withstands the higher grinding pressures of modern paper pulp production. The stone is not solid, but is an assembly of individually made segments bolted to a center. The abrasive is bonded by special clays vitrified at a high temperature in large kilns. The method of assembling and bonding the segments results in a stronger stone than if it were made as a solid mass. The pamphlet describing these stones is furnished by *The Norton Co, Worcester, Mass Gratis*

"NEW MOON" is the name of a magazine published in raised type for the blind It carries a digest of world news, including political events, as well as bits of humor, household hints, and an occasional short story. This publication is issued at special rates, much below the actual publishing cost. Braille's alphabet was perfected in 1834, and that of Dr. Moon in 1847 Until the Braille Institute of America equipped its printing plant for Moon printing in 1933, books in the Moon type could not be printed in this country, and, as a matter of fact, Braille Institute still remains the only concern in the nation equipped for such printing For prices address *Braille Institute of America, North Vermont Ave., Los Angeles, Cal*

ELECTRIC MOTOR LUBRICATION. (*Lubrication*, Vol. XX, No. 3, March, 1934) Protection of bearings and windings of the electric motor when it is called upon to function in the presence of excessive water, dust, abrasive materials, or acid fumes, has received the most careful attention from motor manufacturing during the past few years. The present pamphlet gives a wealth of practical information on such protection. *The Texas Co, 135 East 42nd St, New York City.—Gratis.*

GRAFTING TREES AND SHRUBS (Circular No. 138), by Dr. H. B. Tukey, describes each step in cleft grafting, whip grafting, bridge grafting, bark and side grafting, and hand grafting, or "budding," as it is generally called. Dr. Tukey explains the special purpose of each type of graft and tells in detail how it is made. *New York State Agricultural Experiment Station, Geneva, N. Y. -Gratis.*

ADOBE OR SUN-DRIED BRICK FOR FARM BUILDINGS. (Farmers' Bulletin 1720-F.) Adobe brick for walls of homes and other buildings is practical in the arid southwest and frequently in humid sections where the climate is favorable for curing the bricks. Bricks can be made by unskilled labor, which makes for low building cost.

Homes made of adobe brick are durable, fire-resistant, and comfortable. The Bulletin gives detailed information as to the manufacture of the brick and laying it in different types of structures. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

MODERNIZING THE U. S. S. "MISSISSIPPI"

(*Continued from page 300*)

modernized the *Mississippi* he did not forget to improve the many accessories that increase the health and comfort of the officers and men. The galleys (kitchens), the bakeshops, the potato-peelers, and the dish-washing machines were all reconditioned or renewed.

The crew's barber shop was renovated, a new shoe-repairing machine of the latest type installed, and the capacity of the steam laundry was increased. The men's washrooms and lavatories were rearranged and, most important of all, the capacity of the evaporating plant was enlarged so that the daily allowance of fresh water per man could be increased.

The men have a Ship's-Service Store the profits of which go to support their athletic teams, to pay for their ship's movies, and for entertainments such as Christmas parties. Utilizing some of their surplus profits, during modernization they purchased a complete and modern soda fountain and with it, the latest model ice-cream machine that recently, in Cuban waters, was run to capacity in a vain attempt to satisfy that insatiable American craving for ice-cream sodas. At the same time a new talkie machine with all the latest improvements was installed. And finally, in almost every living-compartment of the men was placed a late-model radio!

TO sum up: The modernization of the *Mississippi* thus embraces a substantial addition to her offensive power by increasing the range of her twelve 14-inch guns; it has added to her defensive power by improving the efficiency of her anti-aircraft guns and by increasing her physical resistance to bomb, torpedo, mine, and guns.

By installing new engines and boilers and by increasing her oil bunkers despite her increased displacement, her speed has been maintained and her radius of action greatly increased. By careful designing, the blisters did not radically alter her underwater body, so her maneuvering qualities have been preserved.

Finally, by increasing the convenience and comfort of the crew, the sea-keeping qualities of the ship have been increased, for the efficiency of the ship during a long campaign would depend upon the morale of the men; by demonstrating a sensible concern for the health and comfort of his sailors, Uncle Sam shows not only a big heart but a wise head. These complicated floating fortresses, with their mass of intricate machinery, capable of over 20 knots speed, depend upon the skill, courage, and endurance of the personnel. Without a contented, robust, self-reliant crew, with each member carefully trained for his own particular duties, these mighty battleships, whether modernized or out-moded, are as useless for battle as a "painted ship upon a painted ocean."

Books SELECTED BY THE EDITORS

THE ROBBER BARONS

By Matthew Josephson

J. P. Morgan, John D. Rockefeller, Commodore Vanderbilt, Carnegie, Jim Fisk, Jay Gould, Jim Hill, Harriman and others—these are the "greedy robber barons" who managed, in the last third of the last century to grab most of the natural resources of this great country, sometimes by one means but often by another. This book is a 457-page account of the rise and dealings of these malefactors of great wealth. It is one of the Book-of-the-Month Club selections and deservedly so. The author knows how to tell a story and, by the way, he has not fallen into that too common habit of the slimy muck raker—over-sensationalizing, crusading, tom-tom beating, ranting; the book is quite calm, in fact. But he had no need to, for the mere facts behind his narrative were capable of doing their own smelling.—$3.00 postpaid.—*A. G. I.*

HEARING IN MAN AND ANIMALS

By R. T. Beatty, M.A.B.E., D.Sc.

THOSE who have a loss of hearing and scientific curiosity concerning the sense of hearing in general will find much in this book which will fill out and enlarge their background. It does not concern cures for deafness but is a study of the extant scientific theories of hearing. It is written in plain language and will be understood if the reader has studied high school physics—much of it if he has not. It has 223 pages and 99 figures.—$4.00 postpaid.—*A. G. I.*

ITINERANTS OF THE TIMBER LANDS

By Gray McClintock

THIS is a narrative of the lives of four wolves in Saskatchewan and it contains plenty of action all through—love making, fighting, killing, outwitting. It also contains a vast revelation of the astounding mentality of the wolf. While reading it one lives in the world of the wolf—mainly a world of insistent scents which continually tell the news from everywhere, a very different world from our own. As this tenderfoot reviewer's sole knowledge of wolfology is based on once looking at two forlorn wolves over a city zoo fence, he would value opinions of this book given by readers who happen to live more than "45 minutes from Broadway" and are entitled to an opinion. Do wolves really reason to the extent and depth which this story depicts? The publishers state that the author, a practical naturalist, writes whereof he knows.—$2.15 postpaid.—*A. G. I.*

FOOD, NUTRITION AND HEALTH

By E. V. McCollum and J. Ernestine Becker, Professor, and Associate, Biochemistry, Johns Hopkins University

THIS small book of 144 pages is packed with the most solid, dependable, scientific facts about food and diet and is free from food faddist tendencies.—$1.50 postpaid.—*A. G. I.*

INTRODUCTION TO MODERN PHYSICS

By F. K. Richtmyer, Prof. Phys., Cornell

THIS is the second edition, revised and brought up to date, of a textbook treatise which has earned an established place in the world of science because of its merit. It covers the newer physics alone—that of the present century—and is intended for readers who have completed a study of elementary college physics and can understand calculus, since it is mainly mathematical. It has 728 text pages, 221 illustrations, and is solidly bound. This is the best known book of its kind.—$5.20 postpaid.—*A. G. I.*

THE SCIENTIFIC BASIS OF EVOLUTION

By Thomas Hunt Morgan, Ph.D., D.Sc., LL.D., Prof. Biology, Calif. Inst. Tech.

THE discovery and study of the gene (transmitter of heredity) has removed evolution from a mere observational basis to a definite science, mainly within the last decade. This is the new scientific basis of evolution and the man who, more than any other, has brought about that same change is the author of this book. In it he explains heredity for readers who already know a little biology.—$3.70 postpaid.—*A. G. I.*

THE OLD STONE AGE

By M. C. Burkitt, M.A., F.S.A., F.G.S.

THIS is a general survey of paleolithic times, by a widely recognized anthropologist who is a member of the faculty at Cambridge University. It will become one of the several standard treatises on ancient man which are now available. It covers ancient man's tools, telling how they were made, also much about the geology connected with ancient man and much about the cave art found in Europe. The added space which most treatises devote to the skeletal remains of ancient man is given over by Burkitt to the subject of flint implements, since he is a leading authority on that aspect of paleoanthropology, and the emphasis of the book is in that direction. It has 246 pages and 30 illustrations.—$2.65 postpaid.—*A. G. I.*

COLLEGE PHYSICAL SCIENCE

By Paul McCorkle, Ph.D. and J. Arthur Lewis, M.A.

THIS book contains the subject matter of the "orientation" course in the physical sciences which many colleges nowadays give to first-year students. It is altogether suitable for the general reader, who would gain from it a general elementary background in astronomy (50 pages), geology (53 pages), meteorology (38 pages), chemistry (60 pages) and physics (100 pages)—in short, an all-around survey of the physical sciences. There are 153 illustrations.—$2.15 postpaid.—*A. G. I.*

THE UNITED STATES AND THE CARIBBEAN AREA

By Dana G. Munro

THOSE who are confused regarding historical, political, and diplomatic events in connection wih Cuba, Panama, Dominica, Haiti, and Central America (especially Nicaragua) will find in this 316-page book, written by the professor of Latin American History and Affairs at Princeton University, just the information they want. It brings together from scattered sources the background facts which the well-informed reader will wish to know. Each country is taken up separately and systematically.—$2.15 postpaid.—*A. G. I.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Sees Danger in Patents on Scientific Discoveries

DANGER in the growing custom of universities patenting for profit scientific discoveries made in their laboratories was recently pointed out by Dr. William H. Howell, Johns Hopkins physiologist and chairman of Science Service executive committee.

This method of taxing the public to support scientific research will result, through its commercial implications, in a decline of laboratory ideals and will alienate public regard for the universities, he said.

Examples of patents on scientific discoveries are those held by the University of Wisconsin through its Alumni Research Foundation on the Steenbock process of adding rickets-preventing vitamin D to certain foods, and by St. Louis University on theelin, the female sex hormone discovered by Dr. E. A. Doisy and associates of the staff of that university.

Dr. Howell sees the patents on scientific discoveries as one factor in a growing tendency to consider research as a business proposition to be controlled through administrative experts.

"When discoveries of practical value are made, they might be patented to protect them from being used by unscrupulous persons," he said, "but the patents should be dedicated to the public by a declaration filed in the patent office."

At present, the profits from such patents are generally turned over to a fund for further research at the university holding the patent.

By the method he proposed Dr. Howell said he believed further scientific work would not be impeded and university research would be maintained on a high plane free from secrecy and commercial temptation.

New Ideas for Railroads

ALTHOUGH earnings of the railroads have been reduced and man power considerably curtailed, indications are that comparatively little recession has taken place as far as new railroad patents are concerned. During the past twelve months over five thousand patents have been issued through the 65 divisions of the Patent Office applicable or relating in some way or another to steam railroad use. . . .

Comfort, speed, and safety for passengers and better and quicker handling of freight are the chief aims of hundreds of inventors, judging from the great number of various types of railroad patents granted each week. Seldom does an issue day pass without the country being more or less richer by one hundred patents of at least some interest to railroad men. Give the railroad public what it wants and then get a patent on it, seems to be the inventor's slogan.

About fifty patents have been taken out during the past two years on improvements in railroad ties, about the same number on tie plates, and over a hundred on rail joints, not to mention those relating to ballast. Although devices to improve track and road-bed construction to insure safety are foremost in the minds of inventors and engineers, each one of the 65 divisions in the Patent Office is utilized by railroad inventors. . . .—*Charles L. Howard, Assistant General Counsel, Western Railroad Association, in* Journal of the Patent Office Society.

Color in Trade Mark

IN *ex parte* Emerson and Stevens Manufacturing Company, Inc., First Assistant Commissioner Spencer held that the company, of Oakland, Maine, is not entitled to register, under the Act of 1905, as a trade mark for scythes, a mark described as a blue-colored coating applied to the blade of the scythe.

In his decision the First Assistant Commissioner stated that the portion of the face of the scythe lying immediately adjacent to the cutting edge and the tip of the blade are free from paint. After noting the holding of the examiner that the paint is deemed to possess merely the utilitarian function of covering all but the cutting edge of the scythe for the purpose of preventing rust and that such a mark does not indicate origin and ownership, the First Assistant Commissioner made the following statements:

"Solid or mass color does not constitute a valid trade mark. Furthermore, the retention of small exposed areas does not avoid the rule of the cases cited. Particularly is this true when, as here, in the ordinary use of the article, the exposed areas will be worn, thereby reducing such areas and increasing the mass of solid color. Eliminating the paint from the cutting edge of the blade is not a fanciful or arbitrary matter but serves a utilitarian purpose in that it permits the prospective purchaser to inspect the cutting edge and likewise facilitates cutting and sharpening. Similarly, the exposed tip will wear in use. The failure to obliterate with color the small area adjacent to the tip does not escape the rule that solid color cannot be exclusively appropriated as a trade mark unless it is applied in a distinctive design such as a star, circle, square, or the like. In the latter case the design does not serve primarily a utilitarian function."

Design Patents Now Issued in Two Weeks

IN accordance with a notice by First Assistant Commissioner Spencer, design patents will now issue more promptly than ever before in the history of the Patent Office. The notice reads as follows:

The Patent Office is now issuing design cases in approximately two weeks after the date of allowance. All cases allowed by the Examiner of Designs on Fridays will be printed and in the issue two weeks from the following Tuesdays.

In order to carry out this program, it is necessary that assignments that are to affect the issue of design patents should be presented to the Patent Office promptly for record, for unless these assignments are in the Assignment Division at the time that the assignment search is made, it will not be possible to put them on the file. In view of the short time elapsing between the allowance and the issuance of these design patents, it is not possible to bring these files back from the Government Printing Office for any purpose whatever.

Beauty Aid Under Ban

MERCHANDISING of face creams, cosmetics, or turtle oil claimed to penetrate and nourish the skin and remove lines or wrinkles, is involved in a Federal Trade Commission case against Worth English, Inc., New York City, cosmetics distributor.

The Commission has ordered this company to cease representing that face creams or cosmetics, or the ingredient, turtle oil, "will penetrate and nourish the skin, remove or reduce lines or wrinkles, build up sagging muscles or underlying flesh, rejuvenate the skin, or build and firm the bust."

Investigation of the contents of the company's products indicated that they do not do all they are represented to do.

Porcelain in Paints

THE Federal Trade Commission has ordered Tuttle's Tite-on Cement Company, Chicago, manufacturer of a cement-like material used as a paint or lacquer in finishing refrigerators and furniture, to discontinue using the words "porcelain" or "porcelain enamel" in the advertisement or sale of its product. In its findings, the Commission said this company's product contained not more than 1 percent of silica and alumina, the main constituents of clay, whereas true porcelain contains large percentages of clay.

Austrian Patents

PATENTS are granted for a term of 18 years from date of advertisement of acceptance of the application.

Patents of addition ("Zusatz-patente") are granted for the unexpired term of the original patent.

Opposition to the grant of a patent may be made within two months after the publication of the application. The opponent may demand costs, and often is granted costs, even if the opposition is not contested.

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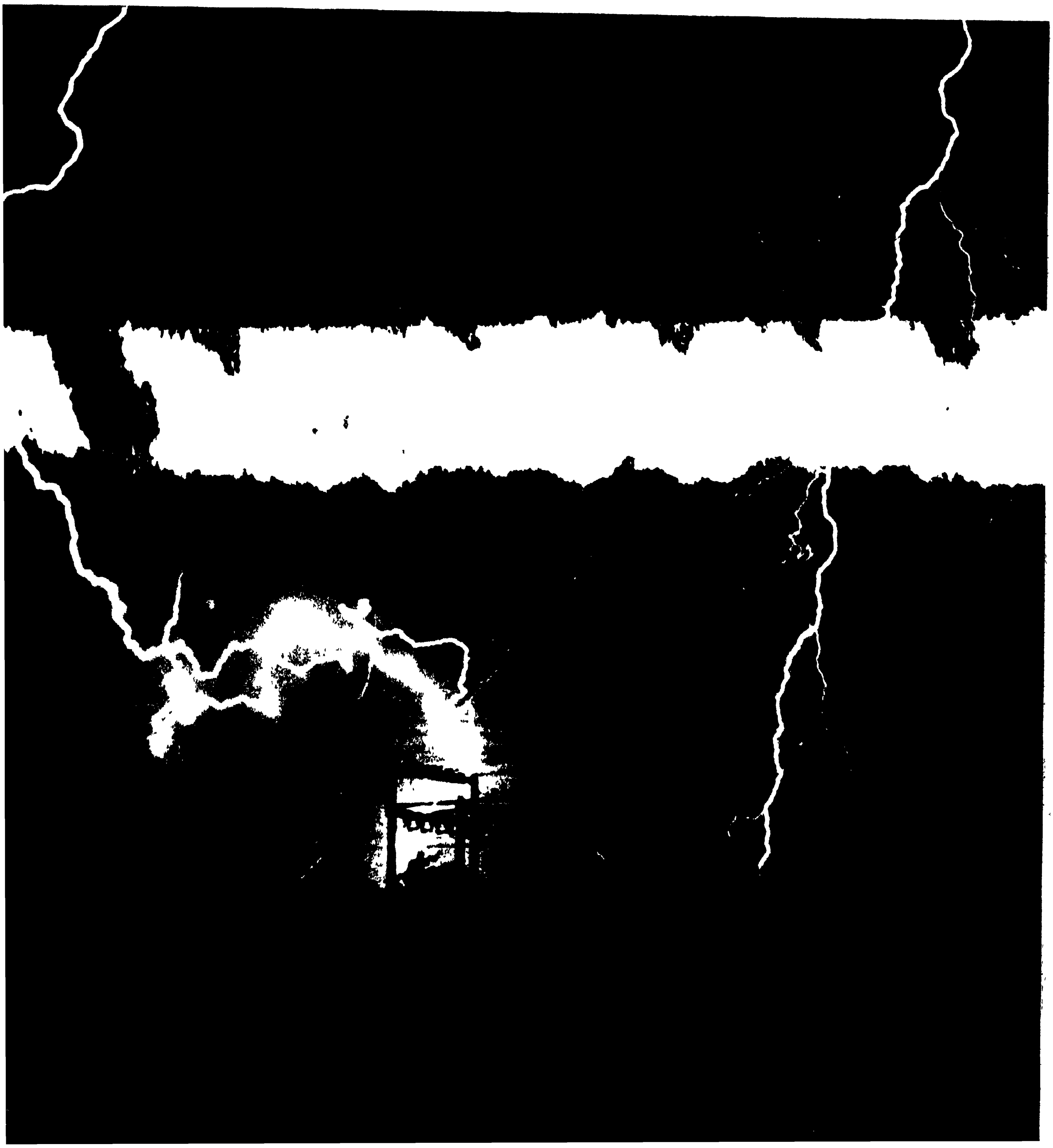

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NINETIETH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

Cover

THE unusually fine example of lightning photography reproduced on the front cover of this issue is published through the courtesy of the General Electric Company. The photograph, symbolical of the forces of nature which man must constantly combat, was taken at Drumright, Oklahoma. The switching station at the left, which the lightning appears to be striking, is in the line of the Oklahoma Gas & Electric Company, and an oil derrick shows in the background.

SCIENTIFIC AMERICAN, July, 1934 Vol No 151, No 1, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc, 24 West 40th Street, New York City. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

CONSIDERABLE interest in the subject of dew ponds has been aroused by the publication of an article in our May 1934 number. Among the correspondence prompted by this article are letters from Professor H. O. Croft, Head of the Department of Mechanical Engineering of the State University of Iowa, and from Dr. F. A. Brooks, Division of Agricultural Engineering, University of California. We hope to be able to publish these and other letters in a future issue but can take space here for only short quotations. Professor Croft writes: "E. A. Martin in the *Geographical Journal* . . . points out that, for the vicinity of the Croydon dew ponds, the natural rain-fall is about 35 inches; the natural evaporation is 18 inches annually; the natural condensation is 0.36 inches annually. This gives a net amount of about 17 inches annually which collects in the pond. This, then, would lead one to suppose that dew ponds may be constructed wherever the rain-fall exceeds evaporation. But should they not be called storage reservoirs?" Dr. Brooks writes: "Although dew ponds are a physical possibility in California, whether they would be practical depends upon the relative expense of obtaining water in other ways. Certainly no experiment should be made without a thorough analytical study and the determination of radiation, nocturnal air-flow, and atmospheric conditions at the location chosen." More of this subject later.

●

AS has been the case with every newly developed industry, that of air conditioning has been surrounded by a mushroom-like growth of semi-truths which tend to mislead the unwary and at the same time to depreciate the value of true air-conditioning in its application to industry and the home. "Air conditioners" for about 25 dollars have appeared on the market, which, upon investigation, are usually revealed as nothing more than a humidifier, a fan, a heating unit, or a cooling cabinet. Even devices which diffuse perfume through the air of the room are advertised as "air conditioners." So much of this thing has been going on that it is little wonder that public ideas about air conditioning are, to say the least, somewhat muddled. We have in hand an article on the subject of popular fallacies regarding air conditioning which will set many of these matters straight. This article will be published in the very near future.

●

"CORN, our major industrial crop, moves steadily toward industrialization. Ever since chemists found the way to break down the kernel into its components, the golden grain has been playing an increasingly important rôle away from the farm. Today, about two million tons undergo factory treatment. The products derived from it are used in more than thirty industries and further penetration is by no means remote." Thus is introduced an article entitled "Industrial Corn" by Phillip H. Smith, scheduled for publication in an early issue. Mr. Smith has prepared an article which tells the whole story of corn and its industrial applications.

NEXT MONTH

¶ Professor Alexander Klemin on research and your motor car.

¶ "Is the Battleship an Obsolete Unit?" by a prominent naval authority.

¶ Rattlesnakes and their bites; how to combat the effects of snake poison.

COMING

¶ S. F. Aaron, well-known naturalist, on the fallacy of the protective coloration theory in nature.

¶ "The Ether: Riddle of the Ages": The present status of this convenient physical concept.

●

ONE of the moot questions of international armaments concerns the battleship and its status in the line of defense. There can be no argument about the fact that since the World War there have developed outstanding advances in war matériel; undoubtedly the most spectacular of these is the airplane and airship. Have aircraft and other defensive and offensive mechanisms rendered the present-day battleship obsolete? The majority of American authorities answer this question with an emphatic "No"; in some other countries the leaning appears to be in the opposite direction. A careful analysis of the battleship as it stands today, showing how it has kept pace with development in other lines, has been prepared for us by a naval authority and has been scheduled for publication next month.

●

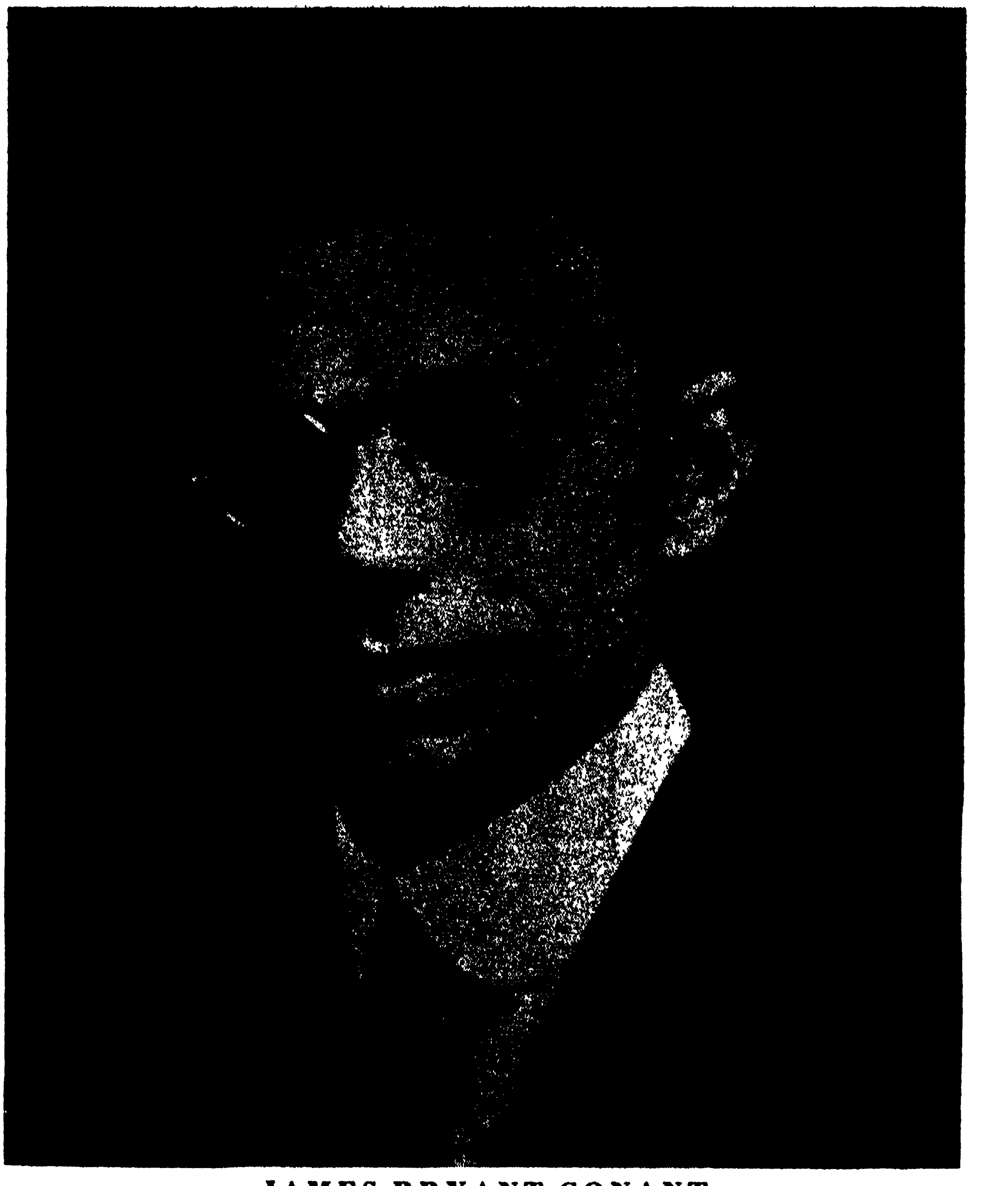
AT this season of the year when hundreds of thousands of people turn to the out-of-doors for recreation, snakes become a popular subject of discussion and fear. Because of this fact it is comforting to note the following quotation from an article entitled "Rattlers and Their Bites" by Will C. Barnes, to be published next month: "Forest officers, cowboys, and others constantly out in the open become accustomed to the thought that reptiles are part and parcel of their daily life and accept the hazard without much concern. With the exception of two or three varieties, common snakes are harmless. . . ." Mr. Barnes goes on to tell of those snakes which really constitute a menace to humanity because of the poison which they inject when striking, and tells of common-sense methods of preventing disaster when bitten by a poisonous snake. One important part of his article is the emphasis of the following statement: "Don't use whiskey."

●

ONE of the treasure troves of the archeologist is located at Ur in Chaldea. So much valuable material is located here that for the past 11 years the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania has been busy locating, preserving, sorting, and cataloging the finds, and the end has by no means been reached. This work is of vast importance to the study of mankind and his progress through the ages. A record of the progress to date and a general résumé of the work accomplished during the 11 years is told in a two-part article by C. Leonard Wooley, Director of the Joint Expedition, the first of which will appear next month.

Orson D. Munn

Editor and Publisher



JAMES BRYANT CONANT

IN recognition of his many contributions to chemical science, Dr. James B. Conant of Harvard University has been awarded the medal of The American Institute of Chemists, presented annually for outstanding service to chemistry in America.

Dr. Conant has done notable work in establishing the chemical structure of many complicated organic compounds, including the hemoglobin of the blood and the green coloring matter of plants, called chlorophyll. He has devised new methods of laboratory technique for better understanding of the mechanism of organic chemical reactions, as well as new modes of attack upon molecules for a deeper insight into the impelling forces which cause reactions to occur. He has established a quantitative measure of the effect of the arrangement of atoms in molecules upon the tendency of those molecules to enter into direct chemical combination.

Dr. Conant has written three textbooks and many papers on fundamental subjects in organic chemistry. In 1932 he was awarded the Charles F. Chandler Medal by Columbia University for his researches in oxidation and hemoglobin, and in the same year the William H. Nichols Medal of the American Chemical Society. He is a member of the National Academy of Sciences, rigorously selected body of ablest American men of science.

Subsequent to the award of these honors and when he was just 40 years of age, he was selected as president of Harvard University—a fact which speaks emphatically of his abilities as a man of science and as a man.

Courtesy *The Du Pont Magazine*

THE DEBRIS ROSE 600 FEET INTO THE AIR

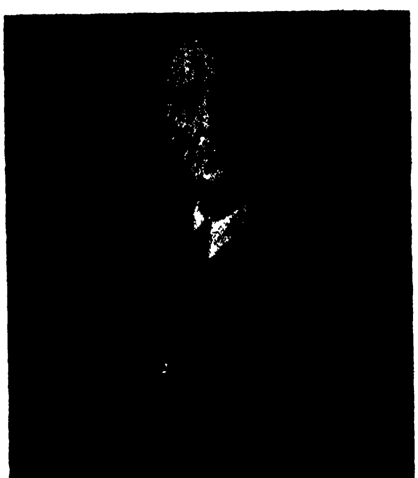
WHERE Ol' Man River swept around Giles Bend, above Natchez, Mississippi, the United States Government Engineers decided to eliminate the 23½ mile kink by constructing a new channel 1½ miles long. Most of the work was done with drag lines and dredges, but at one place it became necessary to use explosives to remove a "high spot" in the channel where cypress stumps were imbedded in tough blue clay. Here a detour channel had to be blasted. This striking illustration shows what happened to the stubborn stumps and the clay when 1500 pounds of ditching dynamite went to work.


Hubert E. Pearce (left) and Dr. J. B. Rhine experimenting for clairvoyant perception. In this case, Mr. Pearce calls off the designs on the Zener Cards, which are left piled up until the end of the experiment

EXTRA-SENSORY PERCEPTION

Results of a Remarkable Series of Controlled Experiments for Telepathy and Clairvoyance

By WALTER FRANKLIN PRINCE, Ph.D.
Research Officer, Boston Society For Psychic Research


Prof. William McDougall, head of the department of psychology, Duke University, and chief sponsor of the work reported herewith

DUKE UNIVERSITY, Durham, North Carolina, has within a few years grown from a college to an institution with about 50 buildings and hundreds of instructors. It is perhaps the first university in the world to offer to its students a course of lectures in psychic research. The head of its department of psychology is Dr. William McDougall, formerly of Harvard and earlier of Oxford University.

Dr. J. B. Rhine is associate professor in the same department. I became acquainted with him in 1926. Beginning about three years ago, he occasionally wrote me, in laconic terms, that he was getting extraordinary results from experiments for telepathy and clairvoyance. Not until he had continued this work for three years and until nearly 100,000 experiments had been made, would he write the report which the Boston Society for Psychic Research has issued in a book of about 180 pages.

Telepathy (perception of thoughts by non-sensory means) and clairvoyance (direct perception of objects by non-sensory means) are included under the term "Extra-Sensory Perception." Both are abhorrent to the large majority of scientific men, in spite of the formidable evidence furnished by many published series of experiments for the former, which no one attempted specifically to impugn, and the hitherto less though still imposing evidence for the latter. Yet many men of high scientific standing have conducted experiments and have become convinced of one or both. Such names as these come to mind: Sir W. F. Barrett, F. R. S. (professor of physics, Royal College of Science, Dublin), Balfour Stewart, F. R. S. (professor of physics, Owen's College, Manchester), Sir Oliver Lodge, F. R. S. (principal of and professor of physics in the University of Birmingham), Henry Sidgwick (professor in Cambridge University), Mrs. Sidgwick (principal of Newham College, Cambridge, and one of the most intellectual women in England), Charles Richet (professor of physiology, University of Paris), Brugmanns (professor at Groningen University), Tischner (professor, University of Munich). Myers, Gurney, Podmore, Bruck, Warcollier, and many other persons of university connection or education with degrees of distinction could be named were there space.

HOWEVER, I do not know that anyone before Dr. Rhine has experimented for telepathy by methods which would not, theoretically, allow the seeping in of clairvoyance. He has conducted a vast number of experiments in such a way as to isolate each from the other. If the agent simply mentally visualizes objects, with no corresponding material objects present, and the percipient gets results beyond chance, telepathy is indicated. If objects (such as diagrams on cards), unseen by any one, are "guessed" rightly in a ratio safely beyond chance, this would indicate clairvoyance.

Dr. Rhine's experiments in both have yielded results so high above chance as to give convincing evidence of both

Table XXXVI

Distance between Agent and Percipient, in P. T.
With Four Subjects
(P. T.=Pure Telepathy)

Item No	Percipient	Agent	Same Room		8-12 feet Wall Between		28-30 ft Two Walls Between		250 miles	
			Trials	Avge per 25	Trials	Avge per 25	Trials	Avge. per 25	Trials	Avge. per 25
1	Cooper	Miss Ownbey	1800	9.2	300	5.8				
2	Miss Bailey	Miss Ownbey	275	11.4	450	9.7	150	12.0		
3.	Zirkle	Miss Ownbey	950	14.0	750	14.6	250	16.0		
4	Miss Turner	Miss Ownbey	275	7.7					200	10.1
			3300	10.6	1500	11.4	400	14.5	200	10.1

processes. Indeed one of the curious and perhaps most unexpected facts which the work seems to indicate is that there must be a close relationship between telepathy and clairvoyance, the major subjects possessing both capacities to a similar degree.

Throughout most of the experiments there were used what came to be called Zener Cards, because they were devised by Dr. K. E. Zener. They were in sets of five, bearing diagrams respectively representing a circle, a rectangle, a plus sign, a star, and two wavy lines. In most of the experiments five of these sets, shuffled, were used together. Let it be remembered throughout this article that when scores of successes are given, the mean expectation of chance was 1 in 5 or 5 in 25.

LET us have an instance of what pure guessing will do. I made 5000 trials with Zener Cards. In the first 1000 I had 209 hits, an excess of 9 above mean expectation. In the second 1000 there were 210 successes; in the third, 199; in the fourth, 193; and in the fifth, 188. None of these, for so many trials, has any significance, and the deviation from mean probability for the 5000 was but 10 (below). Had I guessed on the average 6 cards rightly per 25, I should have had a deviation of 200 above mean chance expectation, or, in other words, it could not have been mere chance, according to the accepted and long established laws of probability.

But turn to Dr. Rhine's subjects and contrast Mr. Zirkle's average of 9.6 successes in 25 in a series of 10,275 witnessed trials for "pure telepathy," or the lumped results of five subjects from 13,750 witnessed trials, part for telepathy, part for clairvoyance, the average score in which was 9. Some series ran below, and even much below, these figures, of course, and some shorter series ran above. But the anti-chance valuation of the three years' work can only be expressed in astronomical figures.

The largest number of experiments were with Mr. H. E. Pearce, jr., a clergyman student. These were all witnessed by Dr. Rhine, his assistant, Mr. Pratt, or both. At first he got only chance average, but rose until he was getting an average of 8.9 correct per 25 "guesses," through 11,250 witnessed trials for "pure clairvoyance."

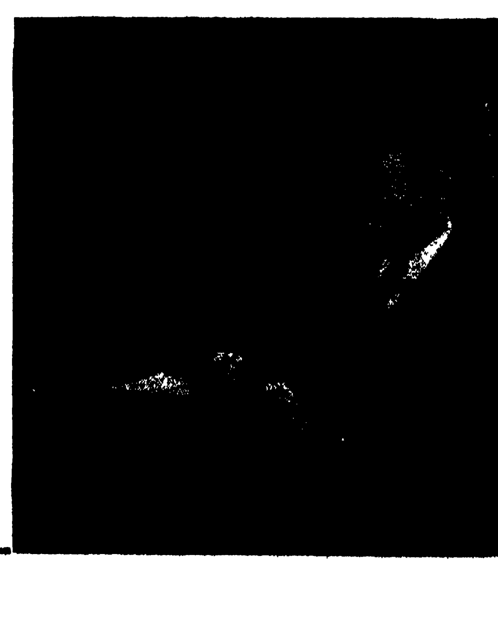
In one of the photographs he is shown at the left working for clairvoyance with Dr. Rhine. He is attempting to name the cards in the shuffled pack of 25 (5 sets of Zener Cards) "down through;" that is, from the top to the bottom card *as the pack lies untouched.* Usually his eyes are closed, and he has an expression of intense concentration. About a dozen other packs can be seen on the table, and from run to run the pack is changed. Under these conditions, in 1625 calls he got 482 right, or 157 more than mean expectation, and an average per 25 of 7.4. Wallace Lee, a magician, after watching Pearce at this work, was unable to offer any explanatory suggestion, and, trying it himself, did not score above chance.

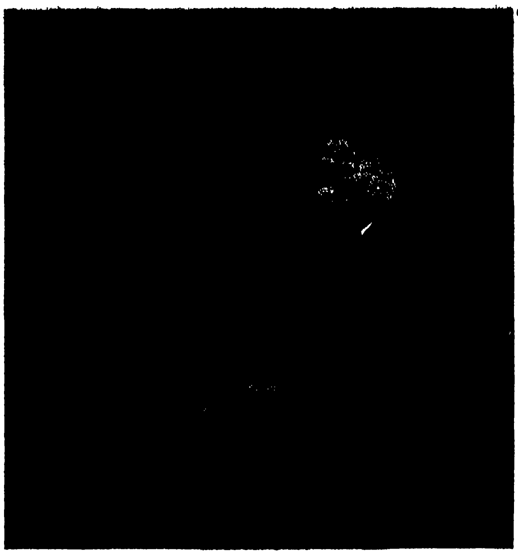
Other photographs show Mr. Zirkle (percipient) and Miss Ownbey (agent) operating for "pure telepathy" in separate rooms with another room between them. The doors were open but neither had sight of the other. The distance between them was about 30 feet. She signaled with a telegraph key for him to make a trial, and did not set down which diagram she mentally visualized until the time prescribed for the trial had elapsed. Under these conditions, out of 250 trials he was correct an average of 16 times per 25. In 750 trials with but one wall between them, his average was 14.6, and out of 950 trials in the same room his average was 14.0. All these results are astonishing, but perhaps it is still more astonishing that the ratio of success grew with increase of distance. The same thing was observed with other subjects, but not all.

OTHER photographs reproduced herewith show Pearce operating for pure clairvoyance, and Pratt in a building 100 yards distant with a pack of Zener Cards, lying backs up, before him. Any new procedure seems to affect Pearce unfavorably at first. Per 25 through 300 trials his scores were 3, 8, 5, 9, 10, 12, 11, 12, 11, 13, 13, 12—an average of 9.9 including the adjustment period. He did better than when in the same room! Afterward the distance was increased to 250 yards, also with remarkable results. Independent sealed reports were made by each to Dr. Rhine. See also Table XXXVI.

It is especially interesting that the introductions of certain factors into the procedure, such as could not conceiv-

J. G. Pratt (left) and Hubert E. Pearce experimenting for clairvoyance at a distance of 100 yards. Mr. Pratt merely handles the cards, does not look at them, but records the figures after a run of 25. The results are compared later. Mr. Pearce averaged 11 hits in 25 cards, as against an expected average of 5 hits





George Zirkle (left) and Sara Ownbey experimenting for pure telepathy. Miss Ownbey signals with a telegraph instrument when a new card is to be used. The conditions under which the test were conducted, and the results obtained, are described here

ably influence pure guessing, did notably influence the scores obtained. Only the last four to be named were experimental; the first two are as valuable as if they were experimental, but unfortunately the number of experiments so influenced was not as large as desirable.

1. When subjects were ill the ratio of hits fell.

2. Sleepiness from fatigue seemed to bring about the same result.

3. Changes in procedure, such as concealing the cards behind a low screen, then a higher screen, then a screen so high as to conceal the whole body of the agent, tended to lower scores for a time, followed by recovery of ratios, after a period of adjustment.

4. One table of the Boston Society's Report summarizes the effect upon Pearce's clairvoyant perception of the introduction of a visitor while a series was in progress. The visitors, in succession, on various dates, were Professors McDougall, Lundholm, and Zener of the department of psychology, J. F. Thomas, Ph.D., Misses Cousins and Bailey, and Wallace Lee, the magician. In every instance the scores of successes markedly dropped following the visitors' entrance, but after a time rose to nearly as high as or higher than the former level. The summarized figures are these: (1) Before entrance, 925 trials, average per 25 of 9.6 hits; (2) lapse period after entrance, 825 trials, with average score 5.5; (3) recovery period, visitor still present, 975 trials, with average score 10.1. Lee was as baffled as the others.

5. The subject Linzmayer, in the midst of work averaging 6.8 hits per 25, was given a dose of the narcotic sodium amytal. His senses remained clear, though he became a little incoherent in speech. But his clairvoyant capacity was destroyed. In 275 trials he scored only 1 hit above average chance expectation. The results of a similar test on Zirkle will be seen in Table XXXIII. A third test with Pearce was fully as striking as these.

6. Giving caffeine seemed to have the effect of improving the score, at least after a period of lowered averages. See Table XXXIII.

The Report is scientifically sponsored, is specific and detailed. Success was not dependent on dictation by the subjects or the deceptive conditions of "physical phenomena." The task of determining the truth with the use of Zener Cards is extraordinarily easy. Miss Turner made up her mind to convince her hitherto skeptical university teacher, Dr. E. She ran 100 trials, with scores per 25 of 8, 11, 7, 7. He simply held the cards behind a notebook. Was that not sufficient? But during the three years many procedures were devised to block every explanation which imagination can suggest.

FOUR members of the psychological faculty witnessed more or less of the work. Several graduate assistants in the psychological department helped in the testing. Some of these got significant results as subjects. Other subjects were graduate students. A number of series are entirely independent in their personnel from any other. It is indeed difficult to suppose that in Duke University there has existed for three years a combination of conspiracy and childish incompetence, involving at its two extremes at least 16 persons, the majority members of the teaching staff of the psychological department, or graduate students of high standing in the same.

Perhaps the unprecedented results are accounted for, in part, by the perfect harmony in the department presided over by Professor McDougall in relation to such experiments, in part by the tactful methods of dealing with subjects by Dr. Rhine and his assistants, and in part by the prodigious patience exercised in trying out and segregating favorable subjects and continuing work with these for long periods of time. We have already seen above that extra-sensory perception appears to be a capacity of utmost delicacy, to be dissipated or lowered by the slightest disturbance.

Dr. Rhine argues with much force against the various "radiation" theories which have been proposed to explain extra-sensory perception. He considers it to be a purely "psychic" faculty, but for all that, "natural," in that it is included in the order of nature.

Table XXXIII

Effect of Caffein and Sodium Amytal on P. T. Scoring
Zirkle, Percipient; Miss Ownbey, Agent
(P. T.=Pure Telepathy. No objects, such as cards, etc.)

Date	Conditions Drugs, etc.	Trials	Hits	Avge per 25	Remarks
	Total, with Zirkle well	1,300	767	14.8	This gives Z.'s normal scoring level.
7-23 7-24	Last 2 days before caffeine test	250	128	12.8	Z. was running about 2 below par.
7-24	5 gr. caffeine	300	176	14.7	The drug brought him up to his average
7-25 7-26	Normal; intervening period	250	136	13.6	Last 2 runs before drug, 7-26 gave av. p 25 of 13.5; this is a check.
7-26 A.M.	5 gr. sodium amytal	300	94	7.8	Very sleepy; drop from 13.6 of 43%, and 9.7 times the p.e. diff.
7-26 P.M.	3 hours after amytal	300	74	6.2	Extremely sleepy. Drop still greater, 54%.
7-26 P.M.	5 hours after amytal; 5 gr. caffeine	300	114	9.5	Rise of 3.3 above preceding; a 53% rise and clearly a significant change.

OUR POINT OF VIEW

Too Much Illumination?

NO DOUBT while you are reading this editorial a man will be accidentally killed, for someone is accidentally killed in the United States every six minutes of the 24 hours or, say, every five minutes of the normal waking hours. Studies made by the statistically-minded show that one fifth of these accidental deaths are the result of poor vision, both poor eyesight and poor illumination.

Dr. Matthew Luckiesh, a leading authority on lighting, tells us now in a new book that one fourth of the school children of this country and one half of the adults have defective eyes, but still we do not regard this as a crying first-class national problem. In order to show that it is just such a problem he asks us to make an odd mental transformation. We are to suppose that all of these people with defective vision have wooden legs instead. Fifty million pairs of wooden legs instead of fifty million pairs of defective eyes. Now you can *see* wooden legs, while defective eyes seldom show their defects to others. The fifty million wooden legs would at once assume the status of a major national issue. None the less, persons with defective eyes are cripples. According to Dr. Luckiesh, much of this defective vision and the accidents caused by it are avoidable. One large source of these accidents is insufficient illumination where we work and live—not merely where we read.

There are, however, persons who worry about over-illumination. As Dr. Luckiesh points out, our eyes, like those of the other animals, evolved under daylight conditions and are therefore adapted to strong light. Few realize just how strong daylight is, even in the shade. For instance, people sometimes compare strong lamp illumination with sunlight. There is no comparison. It happens that, just as these comments are being written at a desk, there is a 300-watt electric lamp at a distance of just seven feet overhead. It is noontime and for a very few minutes at noon the sun sends a shaft of light down into the deep canyon between two adjacent office buildings and this falls on the same desk. Which is the stronger, the illumination of the 300-watt lamp or the sun? Powerful as the lamp ordinarily seems, when the sun breaks in it is literally put into the shade. The patches lighted by the sun make the lamp-lighted areas look like heavy dark shadows. Yet several persons have shown solicitation concerning possible eyestrain caused by the "too powerful" lamp overhead. Man did not evolve under 300-watt lamps. He and his ape ancestors have lived for millions of years under the sun. Old Sol's wattage is high. Our eyes are normally sun-adapted.

Dr. Luckiesh finds that the vision of persons who lead outdoor lives is generally better than that of indoor workers—several times better. This cannot be assumed to prove merely that most outdoor workers do not read much, or that indoor workers do, since he shows that one class of indoor workers who do not read or pore over papers—machinists, blacksmiths, housewives, miners, and so on—have much more eye defect than policemen, farmers, sailors and so on who work outdoors. More than twice as much defect, in fact. The seat of the discrepancy is poor illumination in working places—illumination which seems good, perhaps, but which is still incomparably weaker even than normal daylight in the shade. Many of the fatal accidents which happen every five minutes are doubtless due to this comparatively low level of indoor illumination.

It seems difficult to dispel the bogey of too strong light. The sale of smoked glasses is increasing rapidly. Many seek to exclude the ultra-violet rays of the sun by wearing special lenses, not realizing that all ordinary glass already excludes most of them. Wearing smoked glasses is essentially babying the eyes. The more the eyes are babied the weaker they become and the more babying they ask for. The situation often involves an element of self-induced neurotic condition and is akin to some other health fads. We wonder how early man survived without smoked glasses or tinted lenses.

A time will come when man will be able to duplicate in his home and indoor working places the full strength of normal outdoor environment.

Synthesizing Economic Recovery

SYNTHETIC "cures" for our economic sickness may help the patient. They may, however, act like speak-easy liquor, which serves the purpose of giving a brain-numbing jag followed by a ghastly, oh-why-did-I-do-it hangover, if it doesn't simply kill at once.

Depression cures, remedies, panaceas have been conceived in countless number by economists both practical and impractical. Most of them bear evidence of birth in great travail, of both pedagogic and demagogic background—of nurse-maidism. With sublime egotism, one medicine man after another has announced that *his* plan will inevitably bring complete recovery and prosperity. The demagogues pander to the public lack of courage; the pedagogues proclaim from their scholastic heights; nurse-maids are appointed by the thousands. All seem to have lost sight of, or at least to have overlooked through ignorance or intent, one of the prime fundamentals—and that is: the basic character of the American people. The problem of economic recovery is no simple one to be solved by three words, but a more careful consideration and a full appreciation of this basic character, plus three words, would work wonders. No "sublime egotism" is ours in making this statement, for it is self-evident, obvious to all who have not been blinded by their own negations.

Scanning the record of the past two or three years, what do we see? Industry taking it on the chin and fighting back? No; the record shows no such stirring sight. Anyone could name, offhand, a large number of industries, basic and vital to the progress of the nation, lying prone in complete surrender, like small children awaiting their nurse-maids. As business decreased, these "great ones," with sighs of resignation to the inevitable, discharged thousands, closed down sections of their plants, locked their research laboratories, and cried out their tales of woe for all to hear and sympathize and become more gloomy as a consequence. The record of industry has not been, as a whole, a very bright chapter, but:

There were some who did hold faith in America's finest traditions, who kept their faith with the people they employed and those who supported them. Faced by the chaos of black years, some did not sit down and sob. Instead, they realized that public demand is an unfathomable sea and that when others declare bottom has been reached it is only that the lead line is fouled. These few, working with this fact in mind, have found new depths in this great sea of demand by dint of increased effort and important new products.

There is the classic example of Cellophane. Research made possible this ubiquitous product and an aggressive searching out of possible uses created a demand for it that is still a seven days' wonder. Another that would not accept defeat is a large business machine cor-

poration. As the fog closed around it, this organization did not whine but, instead, employed more salesmen—*yes, employed more salesmen!* The result has been, according to good authority, a satisfactory increase in business.

Consider the case of the producers of a patented laminated shim which obviates the bending or kinking, the unevenness, and general cussedness of solid shims. This company formerly supplied great quantities of shims to the manufacturers of many automobiles. Several years ago, however, the Marmon company brought out an automobile engine in which the bearings had been finished with greater precision so that shims were done away with altogether. The high pressure oiling system resulted and bearing adjustments were greatly reduced. This success led other manufacturers to adopt the new bearing design, and the demand for engine shims dwindled. The shim company's business had been predicated almost wholly on this type of demand, so here was a problem of first magnitude.

The plant and organization put in a great deal of time and spent much money in the effort to find a new product they could produce. They were unsuccessful. They could then have discharged all employees and locked their doors. But they didn't. They began studying possible industrial adaptations for their laminated shims, and found them by the hundreds—or rather, in effect, invented industrial uses where shims would save time and expense and make for a finer end-product. Air compressors, power and transmission machinery, blowers, rolling mill machinery, and several new places in Diesel motors could use shims. Then a far more valuable use than any other was found.

Today in the assembly of many kinds of machinery, an overall accuracy to a thousandth of an inch is necessary. If four or five pieces are to be bolted together, it is hardly practicable to machine each of these to limits of less than plus or minus one thousandth of an inch. Yet a slight error in each would be cumulative so that the total error might be several thousandths of an inch. A laminated shim, however, permits a wider variation in machining—thus cutting costs—because of the wide adjustments the shim allows. Shims of this type, as a consequence of this firm's unwillingness to accept defeat, not only have become again a successful business but also have contributed to the efficiency—and prosperity—of users.

Our point stands proved. Three words—Vision, Courage, Progressiveness—constitute the sanest, surest, least assailable plan for carrying the country forward. What if it does sound like a Horatio Alger "Do or Die," "Sink or Swim" theme? Let the cynic sneer. The fact is that by use of a little imagination new depths of demand can be reached and new demands created; by use of a little extra energy and courage products can be sold; by employing research as never before, progress can be made. It is up to industry primarily *and* to individuals. Our next and infinitely greatest frontier is, as far-sighted men have remarked, the frontier of science and invention, and this frontier extends to the stars!

It is time to stop waiting for the nursemaids, and be up and doing.

Slot Machines

It would seem that published facts and figures which expose slot machines for the cheating mechanisms which they are should be sufficient to deter people from playing them and thus automatically force the manufacturers of these insidious devices out of the racket. But human nature being what it is, legal measures become necessary to protect the thoughtless from their own gambling instincts, which so often are exercised in a direction where they have no chance to break even, much less to win.

It is not the man who can financially afford to spend a few dollars to gain the vicarious thrill of gambling who is the victim of the slot machine. It is, rather, the child with a nickel clutched in his grimy fist and the poor, part-time worker who is induced to part with money which should go for the bare necessities of life. The beckoning finger of easy money lures them on, and having lost what little they have, they immediately lay plans for recouping, and the final result all too often is the beginning of a life of crime.

For years legal battles have been waged throughout the country in an endeavor to suppress the slot machine racket. But so strong have the backers of the racket become, due to the huge profits involved, that in many cases they employ squads of gunmen to protect the territory in which their machines are located. Recently, however, New York state has shown that it is possible to give to the proper authorities legal power which will enable them to cope with the racket directly and without hindrance. The recently signed Esquirol-Robinson bill describes slot machines as gambling devices beyond a shadow of doubt, regardless of what subterfuges may be employed to disguise them as venders.

Armed with the newly acquired power which permits them to seize on sight slot machines whether they be in use or not, New York City police picked up nearly 2000 machines in one day. These machines are not to be considered as personal property, but are to be placed in the same category with unlawfully held fire-arms, and are to be summarily dumped into the Atlantic Ocean. Thus is taken the first real step in the suppression of a widespread racket. Second Deputy Police Commissioner Allen of New York City is to be congratulated upon the speed and dispatch with which he has handled the matter; the Esquirol-Robinson bill is to be recommended to other states for study.

"I Won't Fight"

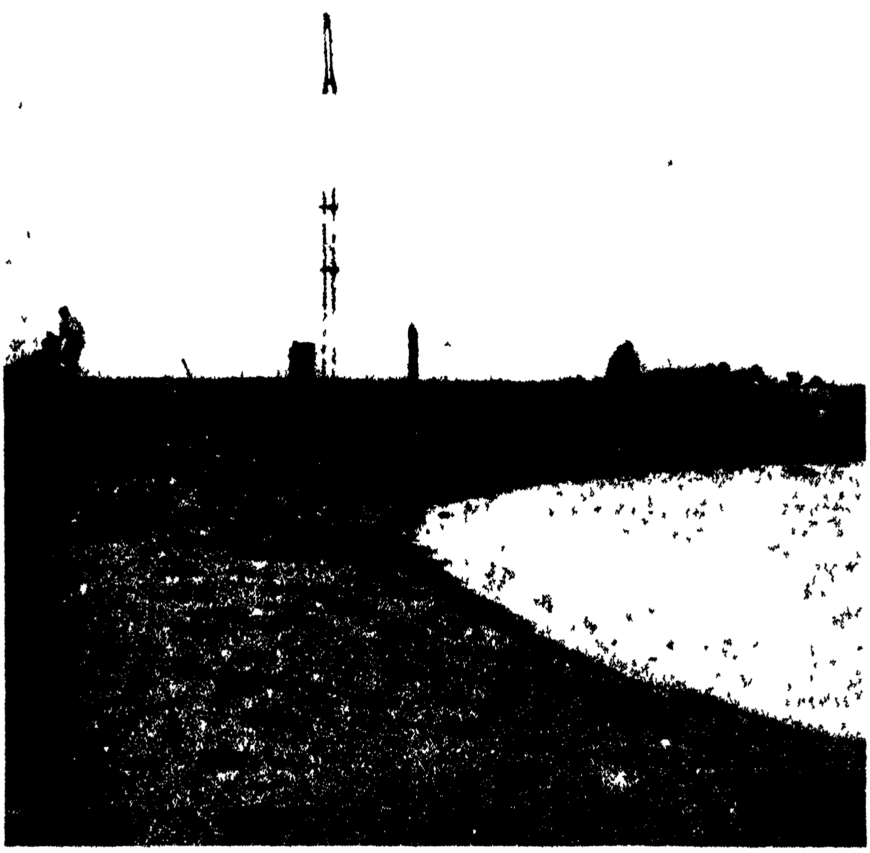
"CALLOW youths without benefit of caps and gowns" is a euphemistic paraphrase of an expression we recently heard describing—with pointed reference to a certain wetness behind the ears—undergraduates who have recently taken up the war against war. Having ourselves passed through the sophomoric stage with egotistical disregard for the experience of our elders in many momentous problems, we would be inclined to smile indulgently were it not for an insidious feature of this battle for a warless world: It is sponsored by subversive elements, by communists, socialists, and other radicals who would weaken the nation so that *they* might gain power. Most of these care naught for American ideals, using foreign racial and religious animosities to dupe and make catspaws of the innocents.

It is of no avail to tell these to read American history to see for themselves that the military forces do not make wars, that preparedness does not start them. (Each of our wars was brought about by the will of the people, the army and navy never even being consulted; and prior to every one we were sadly unprepared.) It would be vain indeed to attempt to show that our present weakness is a menace to world security, that we are tempting aggressive nations by our seeming lack of desire to furnish a stabilizing effect on world diplomacy. It would be foolish to say, to these cunning plotters, that munitions makers do not start wars. In fact, we may just as well be silent; they would not listen for at best they're un-American, know little of our traditions, and hope to force their own unproved theories upon us.

The innocents, however, are another matter. They are simply allowing emotion—adolescent hysteria—to rule. Some years after acquisition of cap and gown, reason will show them that "I won't defend my country" is rather senseless, is quite meaningless. Most of those who waded through blood and muck on the fields of France swore they'd never be fools enough to go to another war. Were they cowards or liars? Just cheerful liars! Most of them would be in the first rush for arms in the event of war, and we miss our guess if the younger generations wouldn't follow closely on their heels. We've been through the whole business and we know the psychology of the youth whose country has been attacked.

WHAT'S IN THE ROCKET?

By G. EDWARD PENDRAY
President of The American Rocket Society



The first successful flight of a liquid fuel rocket in this country, near Staten Island. Mentioned in the text. Because of faulty design this rocket burst at an altitude of about 300 feet, after reaching a velocity of 175 feet per second

A SOCIETY has just been organized in England for the purpose of encouraging experiments with rockets. For some years we have had a national organization of the same kind in this country, which has succeeded in making some important contributions to this much-talked-of but little-experimented-with field. A new local group is beginning an experimental program in Cleveland. In Germany there have been rocket experiments galore for several years. Despite political disturbances and difficulties about money, the national organization of German rocket experimenters is continuing its tests on an important scale. In Soviet Russia several experimenters are at work, with the friendly encouragement of the government, to develop high-altitude and express-carrying rockets. There is a rocket organization in Austria; another in France. The Japanese are also beginning to show interest in this new field of engineering, and have been gathering data lately about the American experiments to transmit to their homeland.

In view of the worldwide attention now centering on the development of rockets, it is time to examine the movement and see what is in it. Are these experimenters hoping to get to the moon? If so, what do they want to go there for? More important still, how will they get back?

Perhaps it is one of the misfortunes of rocket experimental work that imaginative fellows early in the game chose to exploit the possibility that rockets may some day give us command of interplanetary space. The result has been to make every rocket experimenter a little apologetic, and every newspaper man a wit when writing about rocket experiments.

There is plenty of theoretical ground and some evidence for the belief that, given power enough, money enough, and sufficient experimental data, we could shoot a rocket to the moon or Venus or Mars and return. Very likely nothing needs to be discovered that is not already at hand. There are fuels of sufficient power to take us there in properly constructed rockets. The way that such rockets ought to be made (in general) has been worked out theoretically. We have new, light, strong metals and alloys needed for the construction. Patient mathematicians have even gone so far as to solve navigational problems relating to space flight, and to indicate how instruments may be constructed to render such navigation possible.

BUT the moon flight nevertheless is still some time in the future. We must learn to walk before we can run. We must learn how to build a rocket that will travel 25 miles under its own power before we can think seriously of constructing one for a voyage of 250,000 miles. To talk of moon flights now is about as sensible as plans for a non stop round-the-world airplane flight would have been in 1900.

One of the major reasons why no serious experimenter has yet attempted to build a real moon rocket is the magnitude of the job. The chief hurdle is not to get as far away as the moon, but rather to escape the gravitational attraction of the earth. At ordinary speeds it would require such tremendous quantities of fuel that an interplanetary flight of any kind would be out of the question. But physicists tell us that if we can reach a speed of about 25,000 miles an hour—more exactly, 6.664 miles a second—we can then shut off our power. Provided it is outside the earth's atmosphere, our rocket will thereafter coast to its objective on its momentum, forever outflying the steadily weakening attraction of the earth. Whether it reaches the moon, Mars,

Venus, or some other body in space, or falls into the sun or soars out of our solar system altogether, will depend mainly upon its original aim. If peopled by a crew, a faulty aim may probably be corrected in space—depending on the rocket's fuel reserve and the navigational ability of its helmsman. The amount of such correction however will necessarily be limited because of the extra fuel it would require.

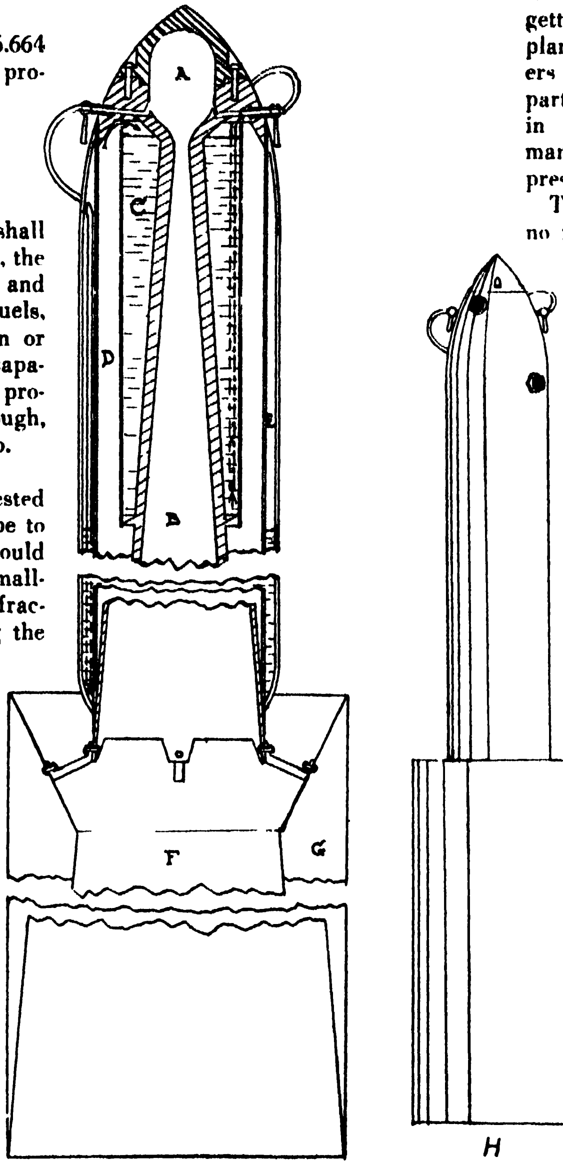
Now, building up a velocity of 6.664 miles a second, especially in a projectile large enough to carry a crew, will require enormous quantities of energy. If the physicists produce their much-discussed atomic energy, it will help us a great deal. If, as is more likely, we shall have to depend on present materials, the likely fuels will be liquid oxygen and liquid hydrogen or acetylene. These fuels, mingled and fired in an explosion or "blast" chamber, are theoretically capable of giving us the speed we need, provided we can devise a rocket large enough, yet light enough, to carry the cargo.

EXPERIMENTERS have suggested that one way to do it would be to construct a "step rocket." This would consist of a series of rockets, the smallest carrying the passengers and a fraction of the fuel, the next carrying the first and a larger quantity of fuel, and the third and largest carrying a great deal of fuel and the other two rockets as excess or "pay load." The largest step would be shot first. When burned out the hulk would be detached from the other two rockets and the second rocket ignited. It, too, would be dropped off when empty, and the fuel remaining in the smallest step would be used to build up the final speed, and to supply energy for maneuvering in space.

Three such steps, it has been calculated, should be enough to get us forever away from the earth. If we are going to the moon, a single additional step—four in all—would bring us back, because the moon's gravitational attraction is much less than that of the earth. If we are going to Mars, we would probably need two additional steps; to Venus three, to provide energy for the return.

Now, if we assume a pay load of ten tons, consisting of a crew of four men and necessary equipment, and a 3 to 1 ratio of fuel to non-fuel load, the total weight of a three-step rocket, ready to start on an interplanetary journey, would be about 5120 tons. This is certainly not an impossible size for such a craft. But when it comes to adding a fourth and fifth step, the total starting weight mounts with great rapidity. The first steps would work out about as follows[1]:

Fuel	Pay Load	Construction	Total
First Step			
60 tons	10 tons	10 tons	80 tons
Second Step			
480 tons	80 tons	80 tons	640 tons
Third Step			
3840 tons	640 tons	640 tons	5120 tons



A rocket designed by Bernard Smith and the author. Height, 66 inches, weight, 20 pounds, thrust, 60 pounds. *A*, combustion chamber; *B*, exhaust nozzle; *C*, gasoline tank; *D*, nitrogen pressure tank; *E*, oxygen tank; *F*, thrust augmentor; *G*, parachute; *H*, exterior view

A fourth step added to this rocket would have to be large enough, obviously, to carry all the others as pay load. Assuming the same ratio of pay load, fuel, and construction, it would bring the total weight up to about 40,960 tons —an interplanetary vessel about as large, though probably not as costly, as a first-class battleship.

These figures give a pretty graphic idea why we haven't gone to the moon long ago, and why it will probably be some time yet before a successful interplanetary attempt is made.

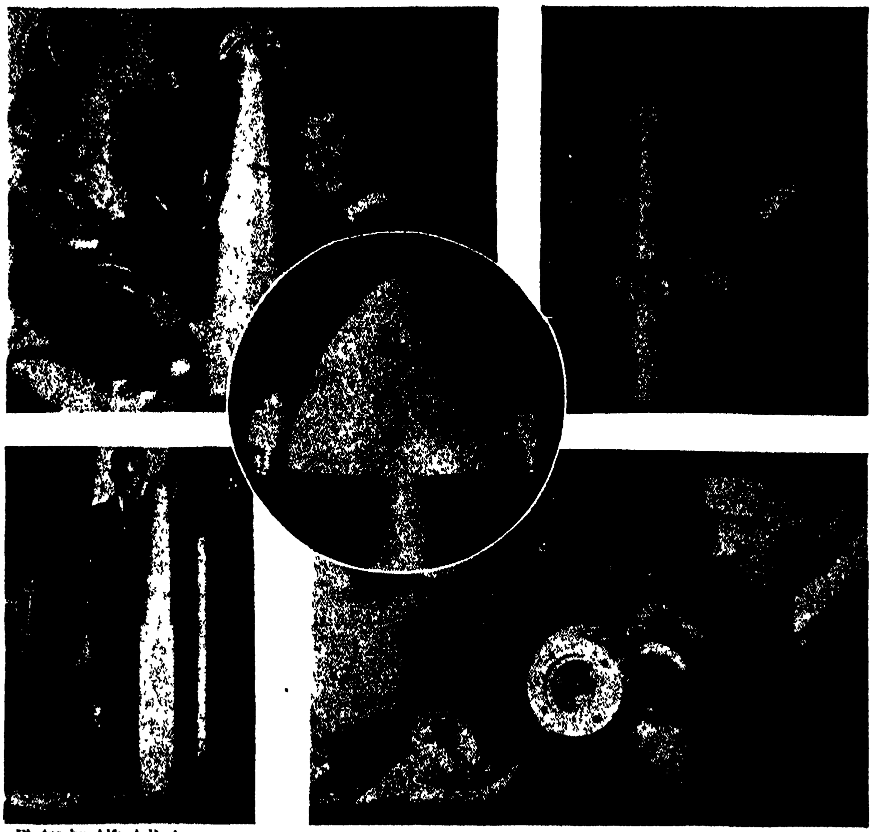
Fortunately there are other uses for rockets, much closer to home; uses which, like the automobile and airplane, may work a new and greater mechanical revolution in our civilization in the next 25 or 50 years. Without forgetting the ultimate appeal of interplanetary flight, the rocket experimenters now active in this country and other parts of the world are more interested in developing smaller rockets, unmanned, which will fill present and pressing human needs.

The rocket, unlike other engines, has no moving parts, and consequently offers certain advantages displayed by no other device for turning heat into motion. If a rocket goes fast enough, all of the energy of its fuels theoretically can be changed into motion. Its efficiency would therefore be nearly 100 percent, whereas the best gasoline or steam engines fall below 25 percent. To realize this high efficiency however, the rocket must travel at a speed equal to the velocity of the molecules of the gases being ejected from its nozzle. This velocity varies with the fuels and other conditions, but is of the order of a mile a second.

AT first glance this seems so fast as effectually to bar the use of rockets in any ordinary pursuit. Indeed, it does blast the hopes of those early enthusiasts who sought to tie rockets to automobiles, railroad cars, and airplanes, with the idea of supplanting gasoline and steam engines for this work. At the low speeds traveled by cars and airplanes, rockets are woefully inefficient; the amount of fuel that has to be carried to keep them running defeats the whole idea.

Fortunately it is not necessary to hitch this Pegasus to a wheelbarrow. In the lower portions of the earth's atmosphere speeds of a mile a second would be out of the question, but the density of the atmosphere falls off rapidly, and at an altitude of about ten miles there is only about one tenth as much air as at sea level. Rockets could travel at their full speed in the stratosphere. Thus, if we wished to shoot a rocket from New York to Paris, instead of dawdling along for 26 hours as Lindbergh did, we could make the hop in about 50 minutes, or, allowing plenty of time for reaching the stratosphere at the beginning and maneuvering for a landing at the end, a maximum

[1]After calculations by Hermann Oberth, an Austrian rocket experimenter.



Photos by Alfred Best

Rocket shown on preceding page. *Circle:* Blast chamber and fuel inlet valves. *Upper left* and *upper right:* Bernard Smith with motor assembly. *Lower left:* The unfinished rocket. *Lower right:* Looking into blast chamber toward nozzle

of an hour and one half to two hours.

We could bring San Francisco or Los Angeles within an equal time-distance from New York. Possibly successful rocket shots carrying mail and express—even passengers—could be made between New York and Chicago and other relatively short distances. For cities separated by less than about 1000 miles, however, we shall probably have still to depend on the old-fashioned airplane, automobile, and railroad, for it would hardly be economical to operate rocket routes over short distances. The flight from New York to Chicago would take about 20 minutes to half an hour.

TO modern ears, which have heard the roar of fast airplanes, these predictions should not seem so very fantastic. However, I think we need not look even for New York-Chicago rocket flights for a year or so yet! This will be the running stage of rocket development, and we have not yet learned to walk.

The experiments now being made in this country by the American Rocket Society and its contemporaries abroad look mainly toward the development of so-called altitude rockets. It is the aim of the experimenters to develop rockets that will shoot straight up to a given altitude, carrying various kinds of scientific instruments to gather data in the stratosphere. Such rockets, to be useful, must be thoroughly dependable. They must be capable of reaching the height determined upon, of making a strictly vertical flight, and finally of returning gently to earth with their precious instruments.

The first step in constructing them will be to select the proper kind of fuel and devise ways to control it. One of the fuels must be oxygen, presumably in liquid form. Liquid oxygen boils at an exceedingly low temperature (-182.9 degrees, Centigrade) and is hard to keep, especially in a rocket where only a few feet away combustion is releasing heat rivaling that of an oxy-hydrogen flame. The other fuel now being used in most American and German experiments is gasoline.

This combination, liquid oxygen and gasoline, gives an explosive force approximately ten times as powerful as T.N.T. Rockets so fueled are no toys for children to play with. Rocketry has already had its martyrs—Max Valier in 1930, and only a few months ago Reinhold Tiling and two of his assistants, to name only four of them. Several others have been injured, including Dr. Robert Esnault-Pelterie, the French aeronautical engineer, who lost several fingers in an explosion of rocket fuels.

Nevertheless, the two fundamental problems of rocketry—how to use and control explosive and volatile liquid fuels, and how to burn them properly to produce the necessary thrust, have been solved. A year ago, on a sandy island off Staten Island, New York, the experimenters of the American Rocket Society, then called the American Interplanetary Society, shot a liquid fuel rocket which, despite the fact that its oxygen tank burst at 300 feet because of excess pressure, demonstrated beyond a shadow of a doubt that the motor and fuel supply system devised by the society's engineers was a success. Liquid fuel rockets had previously been shot—in Germany, by members of the *Verein für Raumschiffahrt* and others, and in this country by Dr. Robert H. Goddard, of Clark University—but none had come so near solving the fundamental problems of rocketry as that of the American Interplanetary Society.

THESE milestones, poor and unimportant as they may seem to persons who dream of conquering interplanetary space, are really fundamental to the conquest of a new engine of transportation. Rocketry today is in about the same position as aviation before the flight of the Wrights at Kitty Hawk. Sooner or later, perhaps yet this year, a demonstration will be made of such spectacularity and consequence that the building of rockets will thereafter become as "respectable" as aviation. When that happens, the country's best engineers, many of them now deterred by the faint aroma of ridicule still associated with the field, will turn to and develop rockets as they have developed aviation and automobiles, both of which went through the same long periods of travail and small experiment.

Rapid advancement today is being much delayed by lack of finances, as is many another important field of experimental work. It is for this reason mainly that rocket societies have grown up here and abroad; experimenters are thus able to pool their resources and ideas, and build rockets which would otherwise never get beyond the plan stage. In this way, also, persons who are interested in rockets and questions of rocket flight but not actively engaged in experimenting, can contribute small sums, through membership dues, toward experimental work, and at the same time receive their fill of rocket talk through the publications of the societies. The American rocket magazine is *Astronautics*, an official publication of the American Rocket Society. The new British group publishes the *Journal of the British Interplanetary Society*. In Germany a periodical, *Die Rakete*, has been published for several years and has recently been replaced by *Das Neue Fahrzeug*.

The rocket societies in various countries now probably total two or three thousand members. The German society recently had more than 1000 members. The American society, much younger, has about 300 members; the British society about 100. Membership in all of them is steadily growing.

FLOWERS WITH YOUR CAMERA

THE ability to make pleasing pictures of flowers depends largely on the knack of seeing flowers as pictures. Flower lovers, possessing the ability to acquire the pictorial viewpoint, may now preserve permanently in picture form the beauty of their gardens with a new type of film which was made available for amateur photographers during the past year. Super-sensitive panchromatic film is highly color sensitive throughout the whole range of colors appearing in the garden. With it well-balanced flower photographs are possible.

Actual colors cannot, of course, be rendered but, in tones ranging from black to white, this film reproduces colors much nearer their true relationships to each other and in their correct values as the eye sees them.

SUCCESSFUL photography can be carried on with very little equipment and with limited experience. Excellent pictures have been made by one amateur with a 3A Kodak equipped with an *f*/6.3 lens, a 75-cent portrait attachment, a tripod, two pieces of cardboard, one grey and one black for backgrounds, and several pieces of string, the last named simply for tying flowers in place.

As a general rule light from directly overhead is not desirable. The slanting rays of early morning or late afternoon sun produce the most satisfactory results. Since the blossoms usually turn toward the sun, the camera should be placed at such an angle that shadows will be cast by parts of the blossoms. This will cause each blossom to stand out individually because of the delicate shadow in each. Perhaps the most ideal time for flower photography is on a hazy day when the sun is under light clouds and there are no air currents to disturb the delicately poised blossoms.

Greater care must be exercised in photographing small light colored flowers than for those of larger structure. Direction and intensity of light must be carefully judged when small delicate blossoms are the subject.

Tree peony. Hazy bright spring day, portrait attachment, 1/10, *f*/22

So much for the "posing."

Having selected your flower subjects and set your camera on a tripod in a position to take full advantage of available light, the flowers are grouped by tying with pieces of string into an artistic arrangement. Often it may be possible to make your picture against a natural background of green shrubbery. Sometimes, however, when either a specially small group is desired or the background is not sufficiently contrasty, cardboard backgrounds of white or varying shades of grey may be inserted.

All arrangements being complete, the exposure is made. As you are familiar with the characteristics of your own camera you will be the best judge of what diaphragm opening to use and how long the photograph must be exposed, bearing in mind that the super-panchromatic film is about twice as "fast" as ordinary film in daylight. The portrait attachment simply permits a close-up not possible with the ordinary camera lens. This portrait attachment naturally is unnecessary for cameras capable of being focused down to close-up positions.

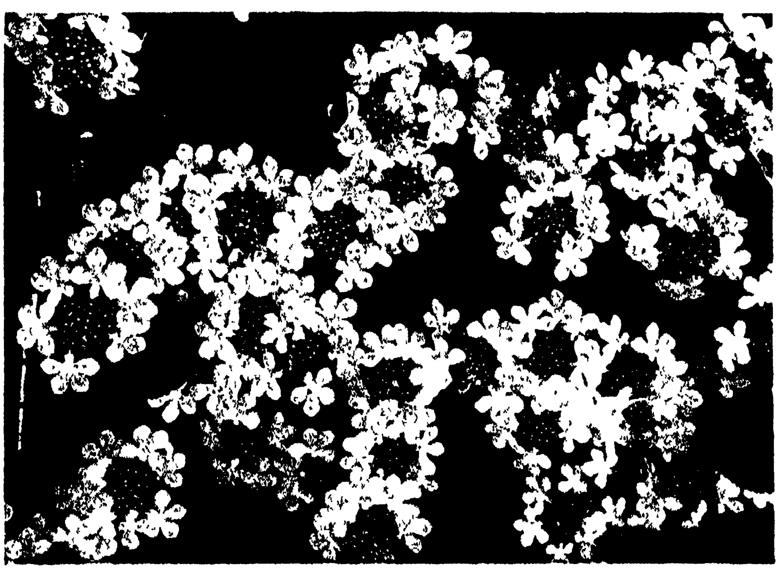
ALTHOUGH panchromatic film is sensitive to all colors, it is more sensitive than the eye to blue and violet light, in comparison with green and red light. The way to prevent blue and violet from having an undue effect upon the film is to use a color filter that will sufficiently subdue them before they reach the film.

For flower photography, the new pale green Wratten X-1 filter, available through dealers from the Eastman Kodak Company, would probably be the most satisfactory to those wishing to do a still more careful job of color rendition than panchromatic film without a filter can do. The X-1 filter gives complete color "correction" with super-sensitive panchromatic film.

Those who already possess a camera color filter would doubtless find it giving a good amount of correction, but the correction would be less complete with panchromatic film than that provided by the X-1.

When the X-1 filter is used, four times as much exposure must be given as for super-sensitive panchromatic film without the filter. When the color filter is used, twice as much exposure must be given.

When a portrait attachment is already over the lens, a filter can be added by reversing it, with the front of the filter against the portrait attachment, and then taping the two elements together.—*Next month: Another article on photography for the advanced amateur.*



Close-up of viburnum blossoms. Hazy light at 11 A.M., exposure 1/10, *f*/22, with portrait attachment over the lens

NEW CONSTITUENTS

In the Existing Maze of Lines in the Solar Spectrum, Those of New Elements Are Still Being Discovered, Adding Further to Our Knowledge of What the Sun Is Made of

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

THERE have been several announcements in the daily press lately concerning the discovery of new constituents in the sun, the stars or the planets. Most of them have been accurate—good evidence of co-operation between investigators and press representatives. But the reader may well be left pondering over various aspects of the matter.

Why is it that, at this advanced stage of physical science, there are new discoveries left to make, especially in so intensively observed a body as the sun? Why have some of the new discoveries dealt with familiar elements such as phosphorous, samples of which can be found in every house where there is a box of matches? And how can the investigator be sure that he is right?

The rudiments of the subject are familiar to us all. The atmospheres of the sun, the stars, and for that matter of the planets, absorb certain specific kinds of light. The spectroscope, by its extraordinary selectivity, separates out the mixed radiation which is fed into it and reveals the gaps. We have then only to find what substance absorbs light of the precise wavelength corresponding to each gap (or dark line) to complete our spectrum analysis. It all sounds very easy, but it is no child's play in practice.

IN the first place, there are enormous numbers of lines to deal with. The solar spectrum, from its ultra-violet limit to the red where Rowland's classical work stopped, contains more than 20,000 lines, some strong, some weak, but all permanently present. The extension into the infra-red with the aid of new types of photographic plates which Mr. Babcock is now making at Mount Wilson, will add thousands more, and still other thousands are found in the spectra of sunspots. All told, the solar spectroscopist will soon have to deal with more than 30,000 lines.

Meanwhile the physicists in their laboratories have been at work on terrestrial spectra, mapping and measuring those of one element after another, down to the very rarest, under varied conditions of excitation. Some elements —for example hydrogen—give simple spectra containing not more than 50 lines. Others, like iron, show thousands of lines, and some heavier elements like the rare earths are even worse. Though the great work of measuring and recording all these spectra is not yet fully completed, the number of lines already tabulated must be more than 50,000.

Only a beginning has been made on the greater task of measuring the band spectra produced by compounds. There are hundreds of compounds which can be set emitting or absorbing light without decomposing them. Every one of them has a spectrum of great complexity, packed so closely with lines in many places that only the most powerful instruments can resolve them. The total number of lines in these band spectra—most of them still awaiting measurement and discussion—may well be a million. It will not be in our days that the spectroscopist need weep because he has no more worlds left to conquer.

ONE might imagine a student set down before two great books, one containing accurate positions of the 30,000 solar lines and another equally good data for the still more uncommon observations of the laboratory, and told to find out what the sun was made of. At first, if he had the spirit of the true investigator, he would rejoice at the wealth of material before him. But very soon he would realize that he was suffering most acutely from the traditional "embarrassment of riches." In every angstrom unit of the spectrum (a tiny bit, only one sixth as wide as the interval between the yellow sodium lines) he would find on the average about five solar lines and as many laboratory observations. There would be fewer in the red, but more in the ultra-violet where the lines are very numerous.

With such a host of lines it is evident that many of them in our list will coincide with some of the others by pure chance. Many of these spurious agreements will be imperfect and can be exposed by more accurate measures, but there will be a considerable residue of cases in which the agreement, though meaningless, is within the error of the best measures. It is possible and, indeed, fairly easy to calculate from the theory of probability how many such accidental agreements within a given limit should be found per thousand lines. Only if, in a given case, we get a decidedly larger percentage of agreements than this, is it worth our while to pursue the subject.

FORTUNATELY, however, we have other tests than this, and simpler ones. The laboratory spectra of any given substance contain lines of very different intensity—some hundreds or even thousands of kinds stronger than others. Common sense suggests that, if we find agreement with solar wavelengths for some of the weak lines while the strong ones are absent, we are deceived by accidental coincidences. But if the strong lines agree with faint solar lines, we need not worry about the absence of weak ones. This obvious test has been applied for decades, but it has some refinements which are not so simple. For example, the spectrum of barium, as observed in the ordinary arc, has strong lines in the red, the orange and yellow, the green and the blue. Three of the orange and yellow lines, and two in the blue, show strongly in the sun. The others, though even stronger in the arc, are not present in the sun at all. This very serious puzzle was solved when it became known that the orange and blue lines were absorbed by ionized barium atoms and the others

OF THE SUN

by neutral atoms. In the intensely heated solar atmospheres, practically all the barium atoms have an electron knocked off them, so that only the first set of lines appear. In the electric arc, though the atoms are ionized in the hot core, they recombine with the free electrons in the cooler "flame" which surrounds it, and both sets of lines appear.

Before we can be sure that an observed coincidence between a solar and a laboratory line has a real meaning we must know not merely the exact position of the two, and their intensities, but also just what the atom or molecule is doing when it produces this line. Is it neutral or ionized? Is it in its normal state, or "excited" by previous loading with a store of energy? And what other stronger lines ought to appear if this one is really what we suspect?

Analyzing the structure of a spectrum itself is curiously like solving a cross-word puzzle, but determining whether an element is present in the sun often requires real detective work.

The obvious cases, like iron and nickel, where hundreds or even thousands of lines agree perfectly, were disposed of long ago. But the hard cases, where only a few of the strongest accessible lines show in the sun and these but faintly, have only been cleared up recently. Sometimes, even now, it is difficult to reach a verdict. For example, two or three of the strongest lines of tin agree satisfactorily with faint solar lines in the ultra-violet. But one other line of about equal strength does not show up. Whether the observed coincidences are mere accidents is not yet certain. We know of no other substance that produces lines in just these positions, but by no means all the possibilities have been exhausted. Osmium is still more annoying. It has several of the strongest lines in the accessible part of the ultra-violet, but every one of these falls so close to a line of iron or some other abundant element that the latter "mask" them in the sun, and we cannot tell whether or not they are there.

SOMETIMES an earlier verdict has to be reversed. Thallium, for example, has two very strong lines (due to the neutral atom) in the green and the ultra-violet. Both agree with very faint solar lines. But the green line is not strengthened in some spots. Now thallium is easy to ionize, and few of its atoms must remain neutral in the sun. In the cooler spots the proportion should increase ten-fold or more, hence if this were really a thallium line it would be notably stronger in the spot spectrum. This coincidence is accidental, and grave doubt is thrown on the ultra-violet line—which cannot be tested like the other, since the spot spectrum has never been observed in this region.

An almost opposite case is that of caesium. This is so easy to ionize that the neutral atoms should not appear, even in the spots. Several strong lines of the ionized atom agree with faint solar lines, but when the spectrum was fully analyzed it was found that these lines were absorbed only by atoms which were not merely ionized but very highly excited. The proportion of atoms which are so greatly stored with energy can be calculated, and comes out vanishingly small, so again a chance agreement has "deceived the very elect."

THOUGH two elements have thus been lost to the list of those recorded as present in the sun when the revision of Rowland's table was published six years ago, five have been added. One of them—platinum—comes in because of new lists of the strongest lines, a few of which were found to be present. Two others, lutecium and tantalum, were added by new and accurate measures in the laboratory which made it possible to be sure of the exactness of agreements that were previously uncertain. Tantalum, by the way, has just been detected by Dr. Kiess of the Bureau of Standards.

Fluorine has been identified in still a new way. The lines of the atoms do not appear, but a compound with silicon gives strong bands which are faintly but definitely present in the sun. Finally, for the moment, we have phosphorus. This is hard to ionize and only the neutral atom and its spectrum need be considered. All the strong lines in this are in the far ultra-violet, hidden hopelessly behind the veil of ozone in the earth's atmosphere of which we wrote a few months ago. Theory indicated that there should be more lines in the infra-red, and these were discovered a year or two ago by Dr. Kiess. Shortly afterward the same spectral region—in the vicinity of 10,000 angstroms—was measured at Pasadena by Mr. Babcock. Miss Moore at Princeton, who has had very extensive experience in these matters, recognized the coincidence of three solar lines with lines of phosphorus. By itself this might be due to accident, but these three lines are the three strongest in the phosphorus spectrum, the next in order having only half the intensity. Moreover, next to the inaccessible ultra-violet lines, they should be the strongest in the whole spectrum of the element. In view of this, Miss Moore's conclusion that the presence of phosphorus in the sun is "reasonably certain," appears to be quite conservative.

Though the lines are weak and there are a few atoms at work absorbing them, the amount of phosphorus in the sun must be very considerable, for the absorbing atoms are in a highly excited state and the number in the normal state (which absorb the ultra-violet lines) is doubtless many thousands of times greater.

FROM the same studies the evidence for sulfur in the sun has been greatly strengthened. Three strong lines were discovered some years ago by a German, Dr. Meissner; the latter work has brought the list up to more than twenty.

Phosphorus and sulfur in the ionized state were identified in the hotter stars several years ago. More recently two elements not represented in the solar spectrum have been identified in stars of the same sort. Ionized neon was detected by Menzel a few months ago, and the neutral element at Mount Wilson a little later (in a cooler star). Now comes from the Yerkes Observatory the discovery by Dr. Morgan of a number of lines of ionized argon in the star Upsilon Sagitarii. Comparison with the strongest laboratory lines leaves no doubt at all of the identification, and one more element is added to the list of those whose existence outside the earth has been demonstrated.

One more spectroscopic announcement came by telegraph from the Lowell Observatory to the recent meeting of the National Academy of Sciences. In co-operation with the University of Michigan, evidence has been obtained that the remarkably heavy bands which appear in the spectrum of Uranus and Neptune, and less strongly in Saturn and Jupiter, are for the most part due to methane. The quantity of gas required to produce so great an absorption must be very large. If some benevolent magnate could only lend the spectroscopists a few miles of large-bore gas pipe, and fill it with the natural gas (mostly methane) which is produced in such enormous quantities, it would be possible to determine how much of the gas there is above the planets' surfaces, and then perhaps to find what the temperature of Neptune must be to keep the gas from condensing.—*Princeton University Observatory, April 29, 1934.*

Splitting Seconds*

Quartz Crystals Furnish the Basis for Time Keeping of Extreme Accuracy

Of the many strange devices to be found in scientific laboratories perhaps none is stranger than a certain unimposing crystal ring in the Bell Telephone Laboratories in New York. From this glistening ring go impulses which regulate great broadcasting stations; impulses which measure the flow of time; impulses which clock the planets in their unending gyrations.

The crystal ring plays an important rôle in the forward march of science. It helps the scientists at the Laboratories in their constant quest for greater knowledge; it permits them to peer further into the unknown and to solve the mysteries and secrets of nature. It divides the second, man's smallest named division of time, into 100,000 parts and, therefore, is capable of measuring periods of a few minutes with an accuracy of one part in 5,000,000!

But why divide the second into such small parts? Wherein lies the need?

The answer is that all of science and much of our everyday life depends upon a few definite standards. To the scientist, the fundamental units are those of length, the centimeter; weight, the gram; and time, the second. The unit of length and the unit of weight are definite, man-made blocks of metal. The unit of time, the second, is a much less tangible thing; and the measurement of time takes us back to the very beginning of time itself.

To trace the evolution of modern time measurement, we must go back to the mysticism, the superstition, and sun-worship of the Chaldeans. These ancient people evolved the seven days of the week from the Sun and Moon and the five planets: Venus, Mars, Mercury, Jupiter, and Saturn. They worshipped the planets as gods and the Sun was their greatest god. The Moon, which ruled at night in place of the Sun, was the god next in esteem. One day each week was set aside for special worship of the Sun and this day became Sun Day or Sunday. Likewise the second day of their week became Moon Day or Monday.

The time required by the sun to traverse its path through the belt of the ecliptic was divided into the 12 constellations of the Zodiac to form the 12 months of the year. The day was divided into 12 hours and for a smaller division of the hour they turned to their mathematical system in which the figure 60, called Sos, was regarded as a mystic

A group of quartz crystals as they are delivered to the cutters' bench

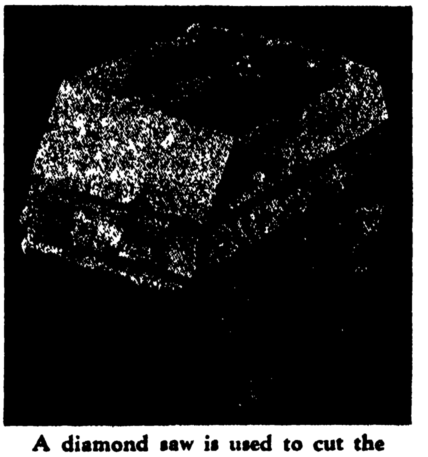
number derived from the five planets and 12 constellations. The hour was divided, by this mystic number 60, to obtain the minute and the minute was, in turn, divided into 60 parts to obtain the second.

The first record of a time machine was that called the clepsydra. The word is of Greek origin and signifies "water-thief." The machine was in reality a water clock which measured time by the ascent or descent of a float on the water in a vessel into which or out of which water slowly dripped.

The first mention of a sundial is found in the Bible (Isaiah, 38:8) in the period of 700 B.C. However, Anaximander, a Greek astronomer (610-547 B.C.) is credited with the invention of the sundial. It is known that the early Egyptians used obelisks as sundials by measuring the time of day according to the length and direction of the shadow cast by the obelisk.

Toothed wheels were known about 300 B.C. but it was not until 145 B.C. that they were first applied to clepsydras to cause a pointer to revolve over a dial plate on which hours were marked. This machine was made by Ctesibius in Alexandria. Pope Sylvester made a clock at Magdeburg about the year 996. In 1583, Galileo discovered the principle of the pendulum, and in 1657, Huygens, who was born at the Hague, presented to the government of his native land the first pendulum clock ever made. From then on, the art of clock making evolved rapidly until today our modern ship chronometers are accurate to about one second each day or perhaps 300 seconds a year.

The second, as it is universally accepted today, is in reality 1/86,400 of the mean solar day, or 1/86,400 of the average time over the period of a year that it takes the earth to make one revolution about its axis. Time, therefore, is a substance of astronomy and for its precise and constant determination, we are in the hands of astronomers.



A diamond saw is used to cut the crystal into slabs of varying size

Nightly, in clear weather, time is checked by observing the transit of the fixed stars as they traverse the cross hairs of powerful telescopes. Hundreds of observations at numerous observatories are the basis of our time. Between observations, we trust to clocks.

Most precision clocks depend for their accuracy on the swing of a pendulum. Under conditions of constant air pressure and temperature, and undisturbed by earth tremors, an astronomical clock can be counted upon to tick off seconds of extreme precision. By adjustments from star observations, any tiny errors that might creep into the rate of swing of the pendulum may be corrected.

Astronomical clocks have certain limitations. They are large, they must be mounted in vibration-free vaults and require the utmost in care and protection. The interval of time they originate is usually an even second. Another device, the electrically driven tuning fork,

*Courtesy Electrical Research Products, Inc.

has been employed as a standard of time, sub-dividing the second into reasonably small parts. Many tuning-fork-controlled devices are in commercial use. But what is the scientist to do if his problem requires an exact one hundred thousandth or millionth of a second? His pendulum device or his tuning fork are of small avail.

We speak in these days of a radio station operating on a frequency of 600 kilocycles, meaning 600,000 oscillations a second. The Federal Radio Commission says this frequency must be maintained between 599,950 and 600,050 per second. This is but one of many cases requiring the splitting of the second into an unbelievable number of exactly equal parts.

TO most of us, perhaps, such fractions of a second are amazing. That they can be measured and counted with an accuracy of one part in millions is still more amazing. But with the aid of the crystal ring, it becomes a simple matter.

The principle on which this ring works may be demonstrated with a common lump of sugar. If a sugar lump is broken in two in the dark a small bluish glow may be seen in the fracture. The explanation of this phenomenon is that when certain crystalline substances are subjected to strain, small currents of electricity are set up in the crystals. Science has known this for many years. It has also known that if a crystal is put in the field of a small pulsating electric current it will vibrate mechanically, and conversely, that it becomes electrified, alternately positive and negative, when pressure is reversed periodically.

Here then is one method of obtaining electric currents at high frequencies by using crystal vibrators which maintain their oscillations with a high degree of uniformity. The action is not unlike that of a pendulum which, as it swings one way, becomes positively charged and as it swings the other becomes negatively charged. Instead of indicating seconds or half seconds by its oscillations, however, such a crystal can be made to indicate millionths of a second.

Great possibilities were seen in these vibrating crystals. The crystal finally decided upon was quartz since it is one of the most stable substances known. The final shape became a ring several inches in diameter and about an inch thick. In a room on the seventh floor of Bell Telephone Laboratories are four of these crystals. Three of them divide the second into one part in 100,000. The fourth vibrates at a slightly different rate and is used for checking the other three. In case lower frequencies are required, intricate vacuum tube circuits, known as sub-multiple generators, step down the frequencies of the crystals to lower ranges. This step-down is made in three stages. One stage steps down from 100,000 cycles to 25,000, the next from 25,000 to 5000, and the final from 5000 to 1000.

Although this apparatus was developed primarily as a standard of frequency, it is inherently a standard of time as well. A frequency of exactly 1000 cycles per second is one in which the individual cycles are each accurately a thousandth of a second in duration. By employing some means of counting the cycles, therefore, a clock is secured that is as precise in its time determinations as is the original crystal oscillator in its frequency of vibration. By using a synchronous motor, and allowing this motor, through suitable gearing, to drive the hands of the clock, the required time-piece is available. The clock, thus constructed and in use at the Laboratories, has a mechanism which gives off one-second impulses and is daily checked against the one-second time signal pulses sent out from the Naval Observatory at Washington from star observations. Even unchecked, the error of these amazing crystals would amount to not more than ten seconds a year, or one part in 3,000,000!

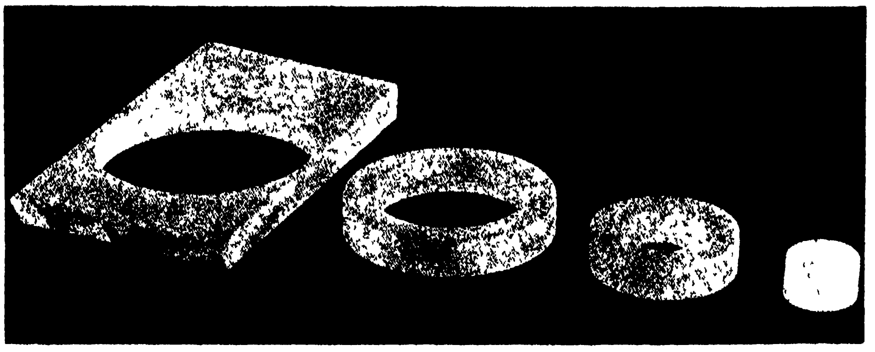
The frequency of the crystal is only to a small degree affected by temperature changes. To eliminate any possible variance, the temperature of the crystal itself is controlled automatically to within a hundredth of a degree centigrade.

THE standard frequency impulses of this crystal oscillator, within the limitations of the transmission system, may be sent by wire anywhere. They may be transmitted over the regular long distance telephone wires. Thus, for instance, high precision electric clocks could be checked from any point in the country by transmitting a standard frequency over telephone wires.

Likewise, wherever a standard frequency is desired, for purposes other than timekeeping, the magic ring stands ready to serve. Many great broadcasting stations now control their transmission frequencies by means of it. Actually, it is possible to control the frequency of every station in the country from this quartz circlet. Indeed, wherever time or frequency measurements are made or compared, this one magic ring may serve as the master for the entire country.

By the use of this master time source, new standards are brought to all users of precision time. Its industrial uses are endless.

It is one of the marvels of our great, modern, mechanical and electrical systems that their control is for the most part centered in devices that are tiny, when compared with the forces they command. The simple little crystal circlet, only yesterday an inanimate thing with unknown potentialities, is today a tool useful for manifold purposes. Through expert scientific research it has become a great controlling force.



After the sawing operation, selected slabs of crystal plate are further cut into rings. The plate, two of the rings, and the core disk are shown above

Various forms into which quartz crystals have been shaped during the course of experimental work. One of the rings mentioned in text is at right

EUGENIC STERILIZATION


The author

Human Betterment Demands It

By E. S. GOSNEY
President, Human Betterment Foundation
Pasadena, California

NATURE'S method of insuring the survival of mankind and promoting a certain amount of progress, was to kill off, by severe conditions of life, the weak and unfit (and, incidentally, many others) while the children of the strong, able, and intelligent had a better chance to survive, reach maturity, and become the parents of the next generation.

The progress of civilization has made many changes in this primitive and ruthless but effective program of natural eugenics. The increasing complexity of culture and science has resulted in the failure of the more intelligent part of the population to produce enough children even to replace their own numbers. The reasons for this, found in a great range of educational, social, biological, and particularly economic factors, are too complicated to analyze here in detail.

On the other hand, these factors have not made themselves felt to the same degree among the feeble-minded, the unstable, the restless, the alcoholic, and the chronically dependent paupers. Not only has the birth rate in these groups continued relatively high, but the progress of civilization, human sympathy, and charity have intervened in nature's plan, rescued these weak and defective children, nursed them to maturity, and allowed them to reproduce children who often perpetuated their own type and weakness.

The resulting trend toward race degeneracy is evident in statistics so well known that they need not here be rehearsed. The average family of the college graduate in the United States has been standardized at two children. The average family which sends a child to the home for the feeble-minded in California consists of four children; and the family which has been dependent upon the county charities for five or more years contains five children.

No one will deny that there is in each generation some degree of inheritance of physical and mental fitness. Therefore, on any theory of heredity it is clear that under existing conditions the average level of intelligence and of physical and mental fitness in the American population is declining steadily from generation to generation. The exact rate of this decline is debatable. The fact that the decline exists, is not debatable.

Every civilized country faces a similar situation, and the past two or three decades have seen a vigorous and determined attempt to meet the problem, on a scale which has not been used since the vain attempt of Augustus to prevent the disappearance of the Roman people, more than 1900 years ago.

THE program of eugenics, though not generally understood, is as extensive as civilization itself. Some measures aim at making parenthood more attractive or less burdensome to the fit part of the population. Others aim at reducing the fecundity of the unfit. One of these measures, surgical sterilization, is so radical, so far-reaching in its possibilities, and so humane in its application, that it has attracted widespread attention ever since it was first used officially in the United States 35 years ago.

The progress of eugenic sterilization has resulted from the discovery of surgical operations that would prevent parenthood without unsexing the individual or altering his life in any other way. "Sterilization", to many, suggests the crude, cruel, and mutilating practice of castration, used for one reason or another since the dawn of history. There is no comparison. The eugenic sterilization operations now used do not remove any gland or tissue, or interfere with any flow of blood or nerve supply. They are a means of protection to the patient, as well as to this and future generations. Such sterilizations, when understood, are therefore usually welcomed by the subject, who feels that further parenthood for him or her is not desirable. Our survey in California shows that, on the whole, the best friends of sterilization are the patients and their families, for they, better than anyone else, know what it means to be protected securely from parenthood which they are unable to meet successfully.

Following the initial sterilization operations in Indiana from 1899, which were done without any law but depended merely on the consent of the patient, the results proved to be so satisfactory that in 1907 Indiana adopted the first of the modern sterilization laws. Such laws are now in force in 27 American states, the following list showing also the year in which the first sterilization statute was adopted:

WHAT DR. ADOLF LORENZ THE FAMOUS VIENNESE SURGEON SAYS OF STERILIZATION:

"I BELIEVE in sterilization of the unfit," said Dr. Lorenz, "because it is the duty of medicine to prevent disease and this is one means of prevention, mental and otherwise.

"I believe it should apply to all mental cases, congenital drunkards, criminals, moral defectives. It is to be hoped it will be successful in Germany, and most probably it will be successful. It eventually will come to all civilized countries as a means of getting rid of the scum of humanity."

Indiana	1907	Alabama	1919
California	1909	North Carolina	1919
Connecticut	1909	Delaware	1923
Washington	1909	Montana	1923
Iowa	1911	Virginia	1924
Kansas	1913	Idaho	1925
Michigan	1913	Maine	1925
North Dakota	1913	Minnesota	1925
Wisconsin	1913	Utah	1925
Nebraska	1915	Mississippi	1928
New Hampshire	1917	Arizona	1929
Oregon	1917	West Virginia	1929
South Dakota	1917	Oklahoma	1931
Vermont	1931		

In addition to this, eugenic sterilization is now on the statute books of the Provinces of Alberta and British Columbia in Canada, of Denmark, Germany, the Canton of Vaud in Switzerland, the state of Vera Cruz in Mexico and the free city of Danzig. Half a dozen other foreign countries are apparently about to adopt the measure and some of them may have done so before this article appears in print.

A measure which thus applies to more than 150,000,000 civilized people, and of which there is 35 years official experience in the United States, has obviously gone far beyond the range of novelty or experiment. Nevertheless, adequate information as to the actual results of surgical sterilization was lacking until a few years ago.

CALIFORNIA adopted a sterilization law in 1909 and it has been continuously applied ever since, with about 10,000 operations to date. This experience therefore represents the largest body of available evidence, and since it extends over a quarter of a century, a careful study of it should be sufficient to furnish conclusive proof as to how sterilization actually works out in practice. In order to satisfy myself and make this evidence available to anyone interested, so that he might study it and draw his own conclusions, I organized a group of specialists in various lines nearly nine years ago and undertook the intensive study of the first 6000 cases sterilized.

Most of the research was done by Dr. Paul Popenoe, a well known biologist and specialist in the field of human heredity, but the progress was followed carefully by many others and all of the material was submitted before publication to a group of critics representing every point of view and sometimes numbering as many as twenty or thirty. Due to the care with which the study was made, its results have at no time been attacked, though they have been spread far and wide, and presumably brought to the attention of every possible type of critic, through the distribution of hundreds of thousands of pamphlets as well as through the original publications in a score of technical journals. These pamphlets, which contain the only first-hand study of any large body of evidence on the subject, are supplied to all who request them, and I consider it a testimony to the impartiality and accuracy of our investigation, that its results are cited as conclusive alike by those who favor sterilization and those who oppose it. The results seemed so important, so cogent, and so worthy of widespread dissemination and study that we organized the Human Betterment Foundation and endowed it in order to carry on this educational work.

Dr. Harry Sharp, called "the father of sterilization." While physician of the reformatory at Jeffersonville, Indiana, he began sterilization there in 1899. There was no sterilization law, but he proceeded merely by obtaining the consent of the patients. It soon became known that the results were satisfactory. In 1905 Pennsylvania's legislature passed the first modern sterilization law. This, however, was vetoed by the governor, leaving Indiana, in adopting a statute in 1907, to be the first of the states to put sterilization into force with actual legal authority. Dr. Sharp is still alive and practicing medicine

The California law applies only to the insane or feeble-minded committed to the state institutions and is compulsory in its character. If it appears to the Medical Superintendent of any one of the institutions that sterilization would be desirable for the protection of the individual, of society, and of posterity, he reports this fact along with the evidence on which his conclusion is based. If the recommendation is approved by the Director of the State Department of Health and the Director of the State Department of Institutions, the operation is then mandatory.

In practice, however, it has been the custom to get the written consent of the patient's nearest relative or guardian, and rarely is the operation carried out against their wishes. In most cases they are anxious to have it done and more and more frequently take the initiative in urging that the patient be not released without this protection.

The operation is thus, in the great bulk of the cases, virtually a voluntary one rather than compulsory. But in every state it has been found desirable to have a compulsory feature of the law and a number of the states which began with a purely voluntary and permissive law have later altered their statues to introduce a compulsory provision.

That such compulsory sterilization is a legitimate exercise of the state's constitutional powers was determined by the United States Supreme Court in 1927, ruling on a test case appealed from Virginia. In writing the decision of the Court on this point, Justice Oliver Wendell Holmes referred pertinently to the character of the case by remarking: "Three generations of imbeciles are enough." He pointed out further that when no one contested the right of the state to demand sacrifice of life on the part of its ablest citizens in time of war, it would be strange indeed if it could not in time of peace demand from some of its least useful citizens, for the protection of posterity, a sacrifice much smaller than that of life—one in most instances regarded as not a sacrifice at all, but rather a protection.

The compulsory feature is desirable, even though rarely used, for a number of reasons. In the first place, the patient may have no known or accessible relatives. In the second place, the relatives may be as irresponsible as the patient himself. In the third place, the husband or wife sometimes wants sterilization done but is reluctant to sign an application, not knowing what attitude the partner might take to it later, and therefore urges the institution to go ahead on its own responsibility. Finally, there are occasional cases in which the family takes a view of the matter which can hardly be shared by their fellow citizens.

A CASE illustrating this point, even though extreme, is presented by a woman with manic-depressive insanity, committed to one of the psychopathic hospitals. Her mother and sister had died insane, her brother had committed suicide while presumably insane, her husband was a sickly carpenter. They already had seven children. The Medical Superintendent told her she would probably be in and out of the hospital the rest of her life and suggested that she be sterilized since she could not take care of the children she already had; since any children she had would inherit some tendency to mental disease; and since any future pregnancy would probably precipitate another breakdown. She said she would talk it over with her husband. Later she advised the Superintendent that they had agreed that she should not be sterilized. "You know," she said, "we already have

(Please turn to page 52)

ANGLING HAS

By J. E. NIELSEN, B.Sc.

How to Take Mean Advantage of a Poor Fish

TO one who is not a fisherman, angling appears to consist of endless waiting and watching for a jerk or tremor in a line with a baited hook, requiring patience far in excess of any other sport.

An angler, however, has abundant time to reflect about countless problems and, besides, the open air provides good appetite. Therefore angling is a healthful and interesting distraction. Furthermore, by the use of scientific methods it can be developed into an intelligent, scientific recreation, with a string full of proof to satisfy the acquired appetite.

The average fisherman uses methods and equipment which are based largely on the oratorical gifts of the salesmen in sporting goods stores. It is remarkable how few are the fishermen who really know the scientific reason for success in fishing or the lack of it. *They unwisely put themselves in the place of the fish and assume the fish to react as they themselves would if they were confronted with a baited hook.* This, for example, is why they believe that the most important property of a float line is that it must not be seen. The fact is that, if the fish should rely on its eyesight alone, all fishermen would be successful. However, because of a difference between air and water the sensory organs of fishermen and fish have developed along different lines. Fish do not see or hear or smell—nor do they taste or feel—as we do, and the different sensory organs are of necessity constructed in quite a different manner in a fish.

In order to allure fish it is therefore necessary to know just what are the important senses of the fish, and how it seems when one puts oneself in their place—the fish, instead of the fisherman.

Take first the sense of vision. In the human eye, light rays enter the first lens through the cornea, which contains a transparent fluid of refractive index the same as water, namely, 1.33. Next it passes through the pupil to the second lens, which has a refractive index of

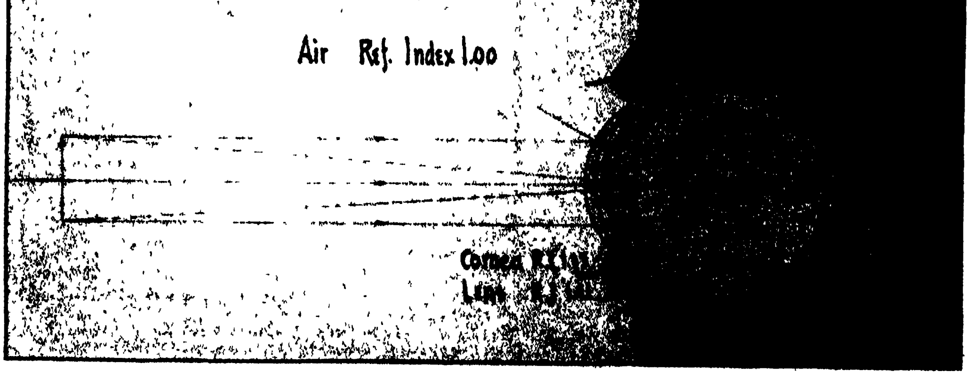
1: Medium sized hook and gut. 2: Fine sized hook, finest gut—good for three pounds. 3: Metal wire, of same strength as last. 4: Metal wire 31/1000 inch diameter, 1¼ pounds

about 1.41. From this it proceeds through almost pure water to the retina, where the image is picked up by the optic nerve.

This device of sight is highly efficient in air, which has a refractive index of 1.00, but when immersed in water, which has a refractive index of 1.33, it is very inefficient. The reason for this is that, as is shown by the principles of optics, light rays which enter the eye will then not be refracted by the first lens but will go through to the second lens in a straight line, and this will have a relative refractive index of only 1.41÷1.33, or 1.06, which is too low to make possible a sharp image on the retina.

IN order to improve upon the low refractive power of the eye of a fish, nature has increased the curvature of its only active lens to the maximum possible, which is the sphere. As we know from optics, the disadvantage of a spherical lens is that only the very central rays will give a tolerably clear image. It exhibits marked spherical aberration. This, combined with the low refractive index, makes fish very near sighted animals. They are able to sense changes in light intensity, but are unable to distinguish between the forms of objects. We then draw the conclusion that the visibility of the float line and hook has no influence on fishermen's luck. We may also see that a flash reflected from a shining spoon or wobbler may allure with the same power as the reflection from the side of a fish.

Next, hearing. In fishermen the ear is divided in three parts: The external, the middle, and the internal ear or the labyrinth. Fish possess only this latter part. The reason for this difference is clear. The function of the ear is to collect vibrations of various frequencies. In the case of humans the ear is surrounded by air and the funnel-shaped external organ is an efficient device for collecting these vibrations, because the medium in which they are set up has a



The human eye in air has a high relative index of refraction, and a perfect image of objects looked at is formed on the retina. Contrast with the author's other drawing on opposite page

SCIENTIFIC ANGLES

density of only one thousandth of that of which the ear is built. Fish, on the other hand, are surrounded by a medium having the same density as that of which they are built, and their whole body partakes of the vibrations set up in this medium. The labyrinth is the only organ required to transfer the physical vibrations to the nervous system. As the receiving nerve centers of a fish are built much the same as ours, we may assume that its sense of hearing is similar to ours—possibly better, on account of the high density of water with which the nerve centers are in direct communication.

THE accompanying article suggests that fishermen should study the special senses of fish and in catching them apply the knowledge thus gained. It mentions the "lateral line" (see sketch of a fish on following page) which apparently enables the fish to feel at some distance the delicate waves of compression set up in the water by a wriggling worm. Many experiments performed on fish by biologists indicate that some of them possess this organ and its "touchy" or teletacting sense.

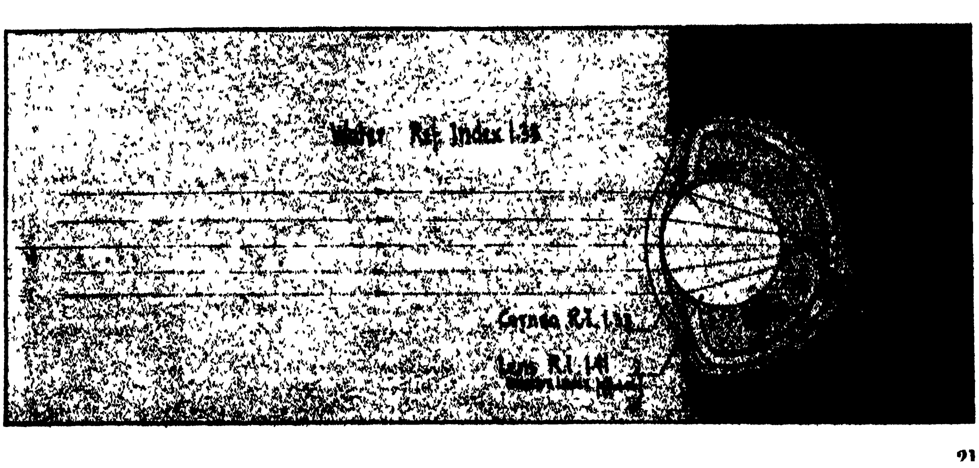
In a 12-page article published in the *Quarterly Review of Biology* (Vol. VII, No. 3), Lucien H. Warner reviews these many experiments, quoting from 37 articles previously published in biological journals, mainly foreign. He states that "blind fish successfully avoid obstacles, and that blinded fish soon learn to do so. . . . As a fish approaches an obstacle the water disturbance caused by its own motion and other water movement is supposedly reflected from the obstacle, and the fish, detecting this low frequency 'echo', avoids the object." The same author tells how one experimenter discovered that the mere approach of a little glass tube caused a blinded fish to avoid it, the tube being successfully located by the blind fish even when moved slowly toward it. When the water was made turbulent the fish still responded similarly, sensing the approach through this "interference."

According to Mr. Warner, not all fishes are deaf but they do not hear so well as air-living animals. They are most sensitive to low-frequency disturbances. Whether this be called hearing or feeling is immaterial, man's difference in nomenclature being based arbitrarily on his own lower limit of hearing, at 16 vibrations per second. What humans call noises must be of great intensity to be effectively transmitted to fish via the air, though jumping on a stream bank readily transmits low-frequency vibrations to them via the earth and water. Fishes have ears for high-frequency sounds but sense low-frequency sounds better, using their "touchy" sense.—*The Editor*.

HEARING and feeling are closely related senses and in the case of fish there is no definite borderline between the two. In addition to periodic sound waves there are other waves—non-periodic pressure waves which humans cannot perceive. A worm wriggling in the water or an insect falling on the surface will set up waves of pressure in the water around them and these will instantly be noticed by the fish. For this purpose, it has an extremely suitable organ, the "lateral line." As we, ourselves, do not possess this organ, it is difficult for us to imagine how its sensations feel, but there is no question that its sensitiveness is far superior to that of fish vision. This fact is affirmed by the strong lateral nerve system connected to it. The best analogy we can give is that of a blind man with his stick, but the fish has long "sticks" in all directions, and every stick has a sensitivity equal to the tip of your tongue—every stick is in fact a "teletoucher." Most fishermen do not pay much attention to this organ, but it is nevertheless the organ which causes more bad luck among fishermen than all the other senses combined. With this organ, fish are able to feel the least "touchiness" in the surrounding medium.

We therefore draw the next conclusion—that fish are more "touchy" than fishermen, and that we should pay closer attention to arranging the float line so that it will be as little likely as possible to excite the special touchy sense of the fish by setting up unnatural vibrations in the water.

The chemical senses, smell and taste, which are separated in fishermen, are combined into one by fish. As the nature of smell is to perceive odorous matter highly diffused in air, and as fish are not surrounded by air, there can be no sensation of smell as it is known in fishermen. There may, however, be a better developed sense of taste, judging from the abundant distribution of taste buttons in and around the mouth and on the sides of the head. It is possible that fish can taste matter highly diffused in water as easily as we smell it in air. Taste and smell are quite different sensations. It is only occasionally that an agreeable smell arouses our desire to eat. Some fine perfumes, for example, have a definitely disgusting taste. The practice of some fishermen of perfuming the bait is useless and unscientific. There is no reason to assume that fish should want violet perfume included in their diet, merely because we like the smell of violets. Most of the "wonder-



The fish's eye is immersed in water, which has a refractive index of 1.33, and the lens, which is spherical, cannot form a sharp image on the retina. Thus fishes have poor sight

ful" prepared baits and prescriptions for baits can be classed as hokum.

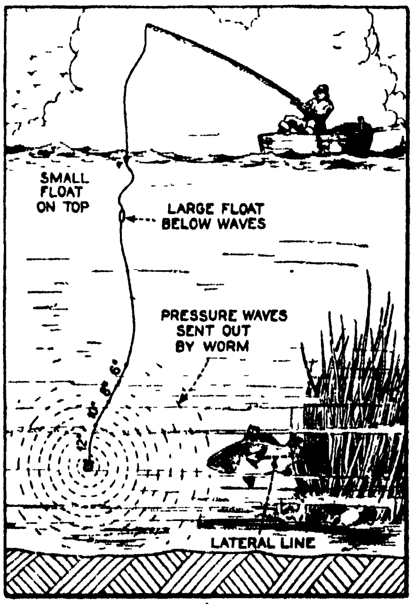
Expert fishermen will tell you that, when it comes to catching fish for the sake of the fish more than for exercise and fresh air, there is nothing more killing than natural bait, preferably live and employed in not too large a quantity. Of this the easiest obtainable is the ordinary pink earthworm, which should be kept in a can with moss. Even on the hottest day there are few fish which will not risk stretching the skin of their bellies a bit more, just to accommodate a nice worm when it starts telegraphing its arrival in the vicinity.

A live bait should always be presented to the fish in as natural a condition as possible. A worm which is threaded on a hook will not be able to broadcast the same pressure waves as a free worm and, by the lateral line previously mentioned the fish will sense danger. Therefore a better way is to hook the worm twice through the skin, about an inch from either end. Other live baits should be presented in a similarly natural way, with as little interference with its broadcasting as possible.

You will often notice that some fishermen, after having waited for some time, pull up the line and change the bait. They may do this repeatedly without the possibility occurring to them that something other than the bait might be wrong. If the bait is properly attached and if the fish refuses to take it, one may make a fair guess that it is the line which is wrong and that its presence is being sensed by the fish—it occasionally happens that they refuse to commit suicide. If the fish senses the float line, the latter must be perfected so that it cannot be detected. Such a line is, however, not to be had on the market, and we must do as real fishermen do—make it up ourselves.

LET us first visualize how we should approach a bait if we were the fish and not the fisherman. First, with our teletoucher, the lateral line, we should feel the wiggling of the worm or the flapping of the fins of a small bait fish at quite a distance, and we should be able to judge the distance and the direction very closely. We might even, if we should stay in one spot for a short time, get a hint of taste now and then from the appetizing bit of nourishment. Still, we do not approach because simultaneously with these pressure waves we feel other vibrations closely associated with the bait which warn us of danger. These vibrations are caused by the float line. We also have the feeling that the bait itself is being moved about in the water in a manner which is not natural for a worm. This is caused by the float following the up and down motion of the waves on the surface. Being a smart fish we do not take the bait, in spite of a healthy appetite. If the surface is quite calm, we may slowly approach it and even touch it, but this touch will instantly tell us that there is something wrong, for the resistance against displacement is different from what we should expect.

AMONG all these appetizing bits that act unnatural, however, we suddenly feel one which acts quite natural, and after a brief hesitation we go straight after it. Coming very near, we taste it more strongly and see its color. We get so close that we can nibble at it, and we see that there is no noticeable resistance. We decide to take it. To our despair we find that we are caught by fishing tackle whose presence we had not been able to perceive, even with our teletouchers and special senses. This tackle is a perfectly balanced float line, its surface friction and volume reduced to a minimum.



Author's sketch, showing his arrangement of floats and line, also a fish "teletacting" a live bait

In order to reduce surface friction we must discard all float lines of cotton, silk, catgut, and so on, as the fine fibers on the surface of these materials give a high frictional resistance. There remains the choice between horsehair, Italian or Japanese gut of the finest size, and metal wire. Of these, horsehair is too weak, even for small fish, and can be counted out. Italian and Japanese gut has a tensile strength of about 50,000 pounds per square inch cross-section and the finest of this is about nine thousandths of an inch in diameter. This can, therefore, sustain a weight of about three pounds. In metal, only chrome nickel wire is obtainable in suitable sizes. This can be obtained at radio stores, where it is sold as resistance wire. Only gage 40 to 31 is of interest to us as float lines. The tensile strength of this wire is about 150,000 pounds per square inch of cross-section. A 31-gage wire, which is nine one-thousandths of an inch in diameter, will carry about 10 pounds, while gage 40, which is three one-thousandths of an inch in diameter and like a fine hair, will carry a weight of one and a quarter pounds. A 36-gage wire will have the same strength as the finest gut, while its surface will have only about half as great an area. Therefore its frictional resistance in water will be only half, and its volume will be a quarter, of that of the gut line. This line will then be twice as difficult for a fish to detect when nibbling, and four times as difficult to feel by means of its lateral line at a distance. If given a fine coat of black lacquer, it will also be invisible to any fish that does not wear spectacles to correct its poor eyesight.

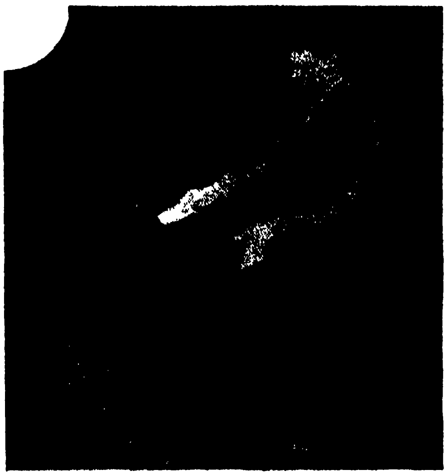
Having made this choice of material, we now build our line on the principles of least resistance against lateral movement. We use as little sinker as possible, dividing it up into small quantities and distributing these along the line. We place the first little ball about 12 inches from the hook, the next one 10 inches farther up, the next again 8 inches, and so on—6, 4, and 2 inches apart if we need that many. It is all a question of how fast we want the line to sink. We now place the float so that the bait will hang at the desired depth—on a hot day quite deep, on a cloudy day higher up, all depending on locality, wind, and weather—and we balance it so that it will just float on the surface, in order that the least additional weight or the least touch of the hook will pull it down under the surface.

Having done this, the float is now divided into two parts, a large part and a small one. We place the large part about 18 inches nearer to the hook than the other. Then it will be totally submerged in the water below the surface waves, while the little float above will remain on the surface and participate in the motion of the waves on the surface.

By this arrangement we shall obtain a perfectly balanced float line with which fish can be caught even under the most difficult conditions. It will be found also that fish caught on such a line are usually well hooked.

OF course, fish can be caught with any kind of line, provided they have a good disposition or are famishing. Unfortunately the latter is not always the case, and at such times he who has the better tackle will usually have the better luck—— Which all goes to show that Pritt was right when he said that one of the charms of angling is that it presents an endless field for argument, speculation, and experiment.

TIME DEFEATS BANDITS



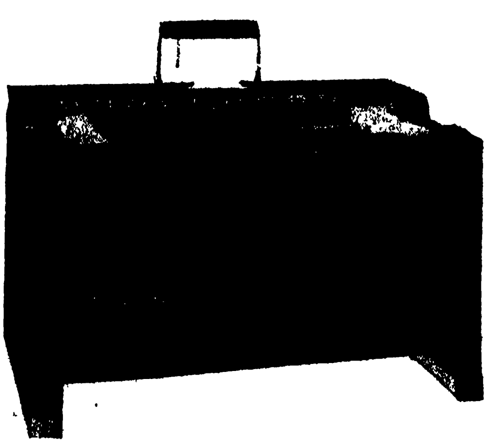
IN almost any form of robbery, the element of time is of utmost importance. If money or valuable records can be protected by a time lock, which is operated while a cashier or other responsible person is ostensibly obeying the commands of a bandit, the attempted robbery will be foiled; the bandit cannot possibly wait for the time-controlled mechanism to work. Outstanding devices of this nature are illustrated on this page.

Left: A cash locker for bank tellers, in which reserve funds are kept in the time-locked lower section

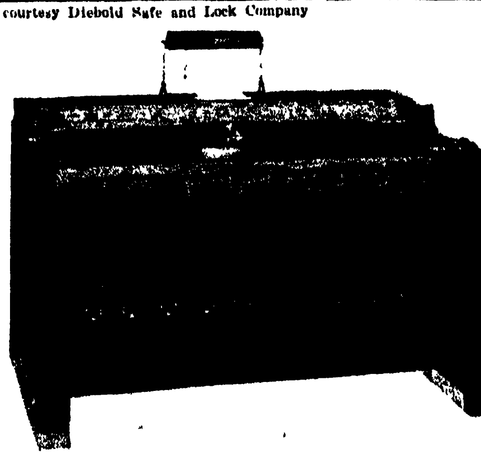
Above: The teller dials the combination on the lower section of the locker in advance of his needs and the delayed control time lock holds the cash in security until the time limit elapses. Should a bandit demand access to the reserve, a label on the locker informs him that he cannot get to the money until a certain time has passed. Since, by the nature of his "business," he cannot wait, there is nothing for the would-be robber to do but to attempt to escape empty-handed

When a custodian of funds is forced at the point of a gun to dial the combination of a safe or money chest, there is nothing for him to do but obey the bandit. In the case of a safe protected only by a combination lock, the robbery is too often successful. If, however, the safe combination is protected by a time lock that starts to function when the combination is dialed, there is no possible way to gain access to the interior until the time limit has passed. A sign informs the robber of the facts. In one type of delayed action lock, a secret signal is sent to a central office when the dial is operated

All photographs courtesy Diebold Safe and Lock Company



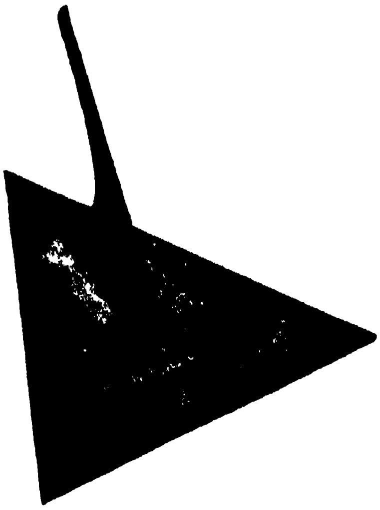
The problem of keeping records and other valuable papers where they cannot be stolen or used by unauthorized persons is of utmost importance to banks and business houses. In the Rekordesk safe shown open at the left and closed at the right, a combination lock protects such property. After the combination has been dialed, pressing of buttons opens or closes the lid in quick time



SUNDIALS AND THEIR CONSTRUCTION—V

Materials for Construction; Calculating Time

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory



A dial fashioned out of sheet lead, by the authors, with tools easily available in the average household

SUNDIALS may be fashioned from almost any material. The most serviceable and preferred materials are hard wood, lead, brass, bronze, and stone. Slate and sandstone are not so serviceable as other stones, because they are more affected by the weather and chip easily. In many cases it is found necessary to use some other material for the gnomon than that used for the dial plate. The most serviceable materials for the gnomon are lead, iron, brass, and bronze. If the dial is to be placed in an exposed place where it will be subject to much handling, lead should not be used for the gnomon, because of its softness.

If a dial is to be cast or cut in stone by one skilled in the art, or if one has the necessary tools, little attention need be paid to the various materials, other than the type desired. A layman will find hard wood, lead, and brass the best materials to use. Many interesting dials have been made of wood. These are usually placed in the wall of a wooden dwelling or other frame structure.

Lead and brass are very suitable for dials which are to be placed in the garden, and their color, if allowed to weather naturally, blends harmoniously into the surrounding landscape.

Bronze and stone are used more for dials which are to be placed where the public has access to them, or for memorials.

In England and Germany there are dials that have been painted on the wall of a building, and the gnomon made of wrought iron. This type of dial is very attractive and especially applicable to a brick or stone building, and it may easily be set up. Most dials of this type have a white background, which may be accomplished by painting.

An accompanying illustration shows a dial made of lead, one-quarter of an inch thick. This dial was made by the authors, and the tools used in its construction were an ordinary cheap hacksaw, jack knife, ice pick, emery cloth, and a small file. The time consumed in constructing this dial, from scratching the lines on the lead to the finishing off, was about four hours.

DIAL "furniture" is a term applied to those additional lines and symbols which are found on many old dials. These lines show the difference between apparent time and mean time; they depict the constellations, points of the compass, equinoxes, zodiacal signs, and so on. Such lines often enhance the beauty, interest, and usefulness of the dials displaying them.

The furniture most commonly found on dials is the lines and figures, which show: (1) the difference between apparent and mean time (equation of time); (2) the sun's declination; (3) the time of sunrise and sunset; (4) the zodiacal signs; and (5) the points of the compass.

In addition to the above, the Babylonian hours (reckoned from sunrise to sunset); the Jewish hours (the old, unequal planetary hours); the Italian hours (beginning at sunset); and meridian lines to show when it is noon at any particular place on the earth, are sometimes placed on the dial plate.

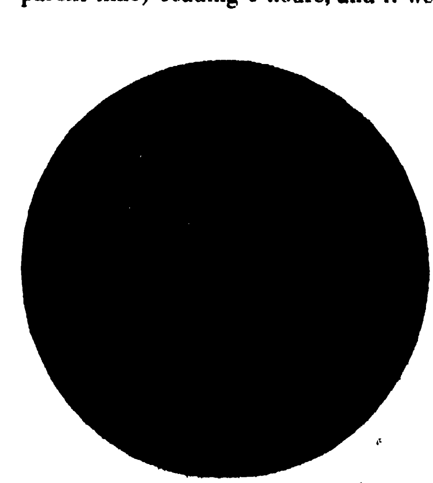
THE discussion which follows next has been written primarily for the layman, in an endeavor to clarify the subject of time, as well as to aid in making sundials more useful and of greater interest to those who possess them.

Timekeeping is based upon the period in which the earth makes one complete revolution upon its axis. For centuries this period, which we call the day, has been divided into 24 equal parts called hours, each hour consisting of 60 minutes, and each minute of 60 seconds. This period may be measured by observing the daily motion of the stars or the sun. The period is determined when the object observed, having completed one revolution, returns to its starting point. For convenience, let us use the observer's meridian as a starting point. Then a solar day would be the interval between two successive crossings of that meridian by the sun.

Because the sun is not fixed, as the stars appear to be, but moves irregularly in a path across the sky, completing a circuit in a year, it is only natural that this interval should vary. Obviously a clock which ticked off 24 hours in the interval of a solar day would be an irregular mechanism, difficult to make.

We look upon a good clock as one that runs uniformly, day after day. For such a clock the day must be uniform in length. If we average the values for the length of the solar days throughout the year a mean (average) solar day will be obtained. Therefore, if a clock is adjusted to tick off 24 hours during this mean interval, it will show what we call *mean solar time*. The irregular solar time is called *apparent* (*real*) *solar time*, in order to distinguish it from mean solar time.

Thus, if we had two clocks (one showing mean time and the other apparent time) reading 0 hours, and if we



Courtesy Odd Fellows of New Hampshire. Photograph by T. F. McCann and Sons Co., art bronze founders

A dial at the Odd Fellows' Home, in Concord, N. H. It reads to the nearest minute. The correction for obtaining standard time is on it

started them off simultaneously, it is evident that in a short time they would disagree. The difference between their readings is called the *equation of time.* The discrepancy between the two clocks is shown in the accompanying table, for every day in the year, where the

equation of time = mean time — apparent time.

Therefore, it is possible to obtain the reading of one clock from the reading of the other for any day in the year, through the medium of the equation of time. For example, from the reading of a sundial, which shows apparent time, it is possible to obtain the mean time of the place or locality in which the dial is situated.

Too much importance cannot be placed upon the determination of the locality of a dial, because a sundial reads noon when the sun is on the meridian of the locality. The reading of a dial in one locality will differ from that of a dial in another locality east or west of it, by an amount equal to the difference in longitude of the two localities expressed in time. (Each degree of longitude is equal to four minutes of time.)

The watch time of everyday life is called standard time and it is derived by referring all observations in certain zones to one meridian near the center of each zone, which is called the standard time meridian. That is, in the United States, they are referred to the meridian of an observer in longitude 75° west of Greenwich for Eastern Standard Time; 90° west for Central Standard Time; 105° west for Mountain Standard Time; and 120° west for Pacific Standard Time. Therefore, in order to convert the reading of a sundial in any locality to standard time, requires:

Photo by S. N. Shurtliff

The sundial on the Bok Tower at Lake Wales, Florida. See the text

Table Showing Equation of Time for Each Day in the Year
Compiled from the American Ephemeris

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec
Day	min.	min.	min.	min	min.	min.	min	min.	min.	min.	min.	min.
1	+ 3.6	+13 7	+12 5	+4 0	—2 9	2 4	+3 6	+6 2	+0 0	—10 2	—16.3	11.0
2	4 0	13 8	12 3	3 7	3 1	2 3	3 8	6 1	—0 3	10 5	16 4	10 6
3	4 5	13 9	12 1	3 4	3 2	2 1	4 0	6 1	0 6	10 9	16 4	10.2
4	5 0	14 0	11 9	3 1	3 3	1 9	4 1	6 0	0 9	11 2	16 4	9.8
5	5 4	14 1	11 7	2 8	3 4	1 8	4 3	5 9	1 2	11 5	16 3	9.4
6	+ 5 9	+14 2	+11 4	+2 5	—3 5	-1 6	+4 5	+5.8	—1 6	- 11 8	- 16 3	— 9.0
7	6 3	14 3	11 2	2 2	3 5	1 4	4 7	5 7	1 9	12 0	16 3	8 6
8	6 7	14 3	11.0	2 0	3 6	1 2	4 8	5 6	2 2	12 3	16 2	8 1
9	7 1	14 3	10 7	1 7	3 7	1 0	5 0	5 4	2 6	12.6	16 1	7.7
10	7.6	14.4	10 5	1 4	3 7	0 8	5 1	5 3	2 9	12 9	16 0	7 2
11	8 0	+14 4	+10.2	+1 1	-3 7	-0 6	+5 3	+5 1	—3 3	13 1	—15 9	— 6.8
12	8 4	14 4	9 9	0 9	3 8	0 4	5 4	5 0	3 6	13 4	15 8	6.3
13	8.7	14 4	9 7	0 6	3 8	0 2	5 5	4 8	4 0	13.6	15.7	5 9
14	9 1	14 3	9 4	0 4	3 8	--0 0	5 6	4 6	4 3	13 9	15.5	5 4
15	9 5	14 3	9 1	+0 1	3 8	+0 2	5 8	4 4	4 7	14 1	15 4	4.9
16	+ 9.8	+14 2	+ 8.8	--0 1	-3 8	+0 4	+5 9	+4 3	—5 0	--14 3	—15 2	— 4.4
17	10 2	14 2	8 5	0 4	3 7	0 6	6 0	4 0	5 4	14 5	15 0	3.9
18	10 5	14 1	8 3	0 6	3 7	0 9	6 0	3 8	5 7	14 7	14 8	3.4
19	10 8	14 0	8 0	0 8	3 7	1 1	6 1	3 6	6 1	14 9	14 6	3.0
20	11 1	13.9	7 7	1 0	3.6	1 3	6.2	3 4	6 5	15 1	14.4	2.5
21	+11 4	+13 8	+ 7 4	--1 2	-3 6	+1 5	+6 2	+3 1	—6 8	--15 3	—14 1	-- 2.0
22	11.7	13 7	7 1	1 4	3 5	1 7	6 3	2 9	7 2	15 4	13.9	1.5
23	11 9	13.5	6 8	1 6	3 4	1.9	6 3	2 6	7 5	15 6	13.6	1.0
24	12 2	13.4	6 5	1 8	3.4	2 2	6.3	2 4	7 9	15 7	13 3	— 0 5
25	12 4	13 2	6.2	2 0	3 3	2 4	6 4	2 1	8 2	15 8	13 0	+ 0 0
26	+12 6	+13.1	+ 5 8	—2 2	—3 2	+2 6	+6 4	+1 8	--8 6	—15 9	—12 7	+ 0 5
27	12 9	12 9	5 5	2 4	3 1	2 8	6 4	1 5	8 9	16 0	12 4	1 0
28	13 0	12.7	5 2	2 5	2 9	3.0	6 3	1 3	9 2	16 1	12 1	1 5
29	13 2	- -	4 9	2 7	2 8	3 2	6 3	1 0	9 6	16 2	11 7	2.0
30	13 4	—	4 6	2 8	2 7	3.4	6 3	0 7	9 9	16 3	11 4	2.5
31	+13.6	---	+ 4.3	--	-2 6	--	+6 3	+0 4	--	16 3	---	+ 3.0

(1) The reduction of the dial reading to the mean time of the locality, by the application of the equation of time.

(2) A further reduction of the mean time of the locality to standard time, by the difference in longitude between the locality and the standard time meridian. This difference must be subtracted if the locality is east of the standard time meridian, and added if west.

The formula for finding the correction to be applied to any dial is:

correction = equation of time + or — (difference in longitude x 4).

The following table shows the correction, to the nearest minute, which is to be applied to dials situated in longitude 78°, 75°, and 72°W, for a portion of the year, as found by the foregoing formula.

Month and Day	Correction for 78	Correction for 75° (Stand Time Merid = Eq of Time)	Correction for 72
Feb.	min	min.	min
10	+26	+14	+ 2
15	26	14	2
20	26	14	2
25	25	13	1
Mar			
1	+25	+13	+ 1
5	24	12	0
10	23	11	— 1
15	21	9	3
20	20	8	4
25	18	6	6
Apr.			
1	+16	+ 4	— 8
5	15	3	9
10	13	1	11
15	12	0	12
20	11	— 1	13
25	10	[illegible]	11
May			
1	+ 9	— 3	—15 etc

It is evident that the formula for finding standard time from a dial is

standard time = apparent (dial) time + or — the correction.

Assume a dial on each of the meridians used in the foregoing example, which reads 3h 30m P.M., on March 20. Then, by using the corrections tabulated above, for those meridians, the standard time for the

78th meridian will be 3h 30m + 20m, or 3h 50m P.M.

75th meridian will be 3h 30m + 8m, or 3h 38m P.M.

72nd meridian will be 3h 30m — 4m, or 3h 26m P.M.

If proper attention is paid to the + and — signs preceding the figures in the tables and in the formulas, one should have no trouble computing the correction to be applied to a dial in any particular place, or converting the dial reading to Standard Time.

The correction may be placed upon the dial plate in various ways; for example, in tabular form, arranging the figures around the dial. Another method, which has been used on large dials, is that of inscribing it in chart form, similar to that published in the second article of this series. A good example of this is on the Bok Tower dial at Lake Wales, Florida.

THE authors wish to take this opportunity to express their appreciation to Dr. Loring B. Andrews, Executive Secretary of the Harvard College Observatory, for giving so freely of his time in reading these articles, particularly the one above and the one which is to follow, in manuscript form, and for his interest and many helpful suggestions.

The construction of the lines which show the sun's declination will be the subject of the next article.

CANCER

How the Scientific Method is Being Applied in One Attempt to Isolate the Ultimate Cause of this Disease

By T. SWANN HARDING

IN two small, most unimposing laboratories in Massachusetts, a vivacious and incredibly mentally active biological chemist, Dr. Frederick S. Hammett, performs and directs some of the most fundamental research on the cancer problem now being carried on in this country. The modest buildings that house the laboratories prove that basically important research does not have to be performed in marble halls. The inadequate physical body, prey to a chronic and dangerous disease that would incapacitate other men, which houses the mind of Dr. Hammett, proves that it takes a great deal more than mere physical disability to conquer the zest of your true scientist.

The two small laboratories are located on the tip end of Cape Cod. One, which is used in the months from May to October, lies in an isolated spot far from the main highway, so that the workers will not be interrupted. It is a small building, 15 by 30 feet, yet it easily accommodates eight research workers in biology. Here tiny sea organisms are brought from the shore not a hundred yards distant and kept thereafter in finger bowls containing sea water drawn right from the very spot in which they naturally chose to live.

The second laboratory is located back of Dr. Hammett's Provincetown home—over his garage, in fact. It is still smaller but is windowed on every side and has a generous skylight as well, through which the sun pours. It is set well back from the street in a grove of Cape pines, and looks out on the bay. Here, during the winter months, the results of the previous summer's experimentation are examined in great detail. Moreover here, and at the big base laboratory in Philadelphia, the chemical foundations are placed for the work of the following summer.

IN this work a group of 14 busy themselves—the others being in Philadelphia. This work we owe to the generosity of the International Cancer Foundation and to fellowships provided by various philanthropically minded individuals. The workers migrate back and forth between laboratories according to the season, and all come under the scientific direction of Dr. Hammett who is a year-'round resident of Cape Cod. But what can all this fooling with sea organisms have to do with cancer?

Pure research, the most valuable kind of science there is, never begins upon an immediate practical problem. It never concerns itself with what can be directly put to practical use. In order to accomplish anything of lasting and fundamental value the research worker must run back some distance before he makes his leap into the unknown. He must be freed from the shackles of practical application and immediate monetary consideration. So, when he hopes to solve even part of the enigmatic cancer problem, he leaps back some

Dr. Hammett, who does his research far from madding crowds

distance, far away from practical methods of cancer treatment, and finds himself among sea organisms.

The Research Institute of the Lankenau Hospital in Philadelphia was presented by Mr. Rodman Wanamaker some years ago. Mr. Wanamaker wanted basic scientific studies to be made on the subject of cancer. The only restriction on his grant was that the approach to the problem be not made by any method that either had been or was being tried. He gave the job of making out the program to Dr. Hammett who, being a biological chemist, naturally drew it along chemical lines. Dr. Hammett's idea was that, since cancers represent growth on a rampage—young undifferentiated cells growing regardless of the body as a whole—he should therefore seek, if he could, what agencies in nature make cells grow and what other agencies, if any, prevent growth.

Growth represents increment in number and complexity, as well as in mass. The organism or unit that has grown is not only larger and heavier; it is also more complex and contains more individual cells than it did originally. The chemical factors that govern mass growth are pretty well known—such things as hormones from the ductless glands, minerals and vitamins in the diet, and so forth. But what factors governed growth as to the number of cells produced? No one knew.

Growth in number is commonly called proliferation, the proliferation of a cancer meaning that the actual number of individual cells it contains has increased. In September 1928, Dr. Hammett started to find out, if he could, why cancers proliferate.

HE did not know where to begin. He had to follow a hunch. He decided first, then, to study the relation between the rate of cell growth in number and cell growth in size in producing a cancer. A cancer grows both because it contains more cells and because those cells increase in size. How does the cancer, therefore, attain its mass size, and how can you stop it?

At the time a great deal was being said about lead stopping the growth of cancers. If so, why? Did it retard growth by preventing the number of cancer cells from increasing, or by preventing increase in mass? The best material for study seemed to be the growing root tips of such things as onions, corn, and beans grown in laboratory beakers. So, just to see what would happen, Dr. Hammett one night dropped a tiny crystal of lead nitrate into one of his cultures. The next morning he found the tip ends of the rootlets discolored.

This was the part of the plant where the cells were dividing themselves up in order to form new cells. Hence lead had some special effect on dividing cells. Trials were then made with many rootlets and the most minute measurements were carried out. Counts were made of over a million cells, in order to determine the number of cells dividing and those failing to divide, in roots exposed to lead and in those not so exposed. It was found that fewer cells divided when lead was present. The cells were no smaller; there were simply fewer of them. Hence lead stopped cell growth because it prevented cells from dividing

to form new cells. But lead did not stop the cells from adding mass to themselves and increasing in substance.

But the lead formed a precipitate or cloudiness in the plant roots at the exact point where they were dividing most rapidly before lead was added to the culture. Since lead hindered the roots from growing, it was reasonable to suppose that it precipitated something out of the roots that was necessary to them if they were to proliferate. What was that? The precipitate was examined under the microscope and it was found to be a compound of lead with a sulfur group in the organism called the "sulphydryl" or, more briefly, the SH group—sulfur and hydrogen. Therefore it seemed that an unusual quantity of this SH material must be present in organisms at points where cells were most active in dividing. It reasoned out that way.

That is what you call scientific logic, and it was working remarkably. It appeared conclusive that the sulphydryl or SH group caused cells to divide rapidly because of its presence near the points of growth. Then you ought to be able to add this chemical group to cultures and make them start dividing like mad.

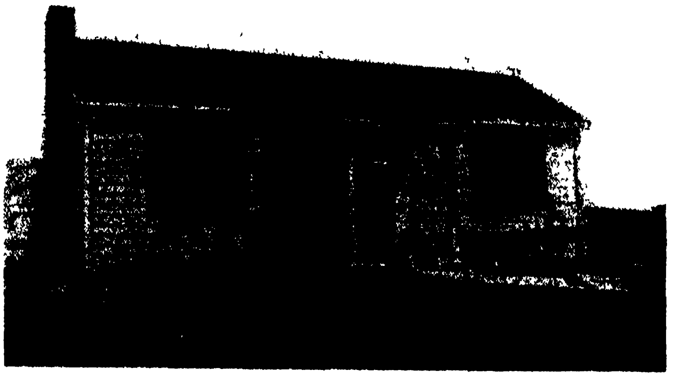
THAT is what Dr. Hammett did next. He first used root tips, but later single-celled animals like paramecia, and in every trial the addition of SH made more cells divide.

But these were all very simple little things; what would happen in a more complex organism—say a rat? Wounds were therefore made in rats. These wounds were then treated with the SH group in proper chemical compounds. They healed much more quickly than wounds in untreated control rats. But suppose ulcers or bed sores were concerned? Could they be healed more quickly? The hypothesis was now tested out with human beings afflicted with ulcers and sores that would not heal. Here, too, cell proliferation was stimulated and healing took place rapidly.

The first practical results of the search have appeared, then. Dr. Hammett did not start out to heal bed sores. That was very remote from his thought. He started out to discover, if he could, why cancers grew so rapidly, and to do that he had to undertake a basic study of growth. But such searches always result sooner or later in valuable by-products because that is the way science proceeds. No matter how remote it appears to be from practice, something helpful always turns up sooner or later.

Ulcers of more than 18 years duration have been healed and the patients restored to comfort and activity. There have been more than 500 such successes, and a recent report of like tenor was made by Simonsen in the *Journal of the American Medical Association*, in an article illustrated with striking pictures.

Even when this SH group, constituting part of the organic compound called "parathiocresol," is rubbed on the skin of a mouse, it makes the skin thicker because the number of cells is increased. Hence benefit to mankind has accrued already from this piece of basically fundamental, so-called "pure" research in biology. This is because the search was made, not for some artificial substance, but for the actual substance which in nature itself makes cell proliferation take place.



The little summer laboratory is an old house. Dr. Hammett is shown at once using a typewriter and absorbing sunshine

But there is more to the story than that. In nature—say in the human body—all cells cease dividing after a time. This is a natural event in their existence. Hence nature must provide some chemical means of stopping cell division. In chemistry we have what is called the law of mass action. For the present purpose it may be said to mean that the products of any chemical reaction always tend to retard the progress of that reaction. Now the body excretes its old used-up sulfur in the form of sulphates. That is the way sulfur leaves our system, though actually in that system it occurs in the sulphydryl or SH form, or in the closely related SS form. Again why?

The body has to oxidize the sulfur after it is through with it and before discarding it. If the body excretes sulphates, it stands to reason also that it has no more use for sulfur in the form of sulphates. Hence it must be some other form of sulfur, not the sulphates, which retards cell division. Where and how does this change from SH to sulphate—this oxidation—take place? Possibly it occurs by a series of steps and perhaps, thought Dr. Hammett, one of these steps might be the retarding agent for cell division.

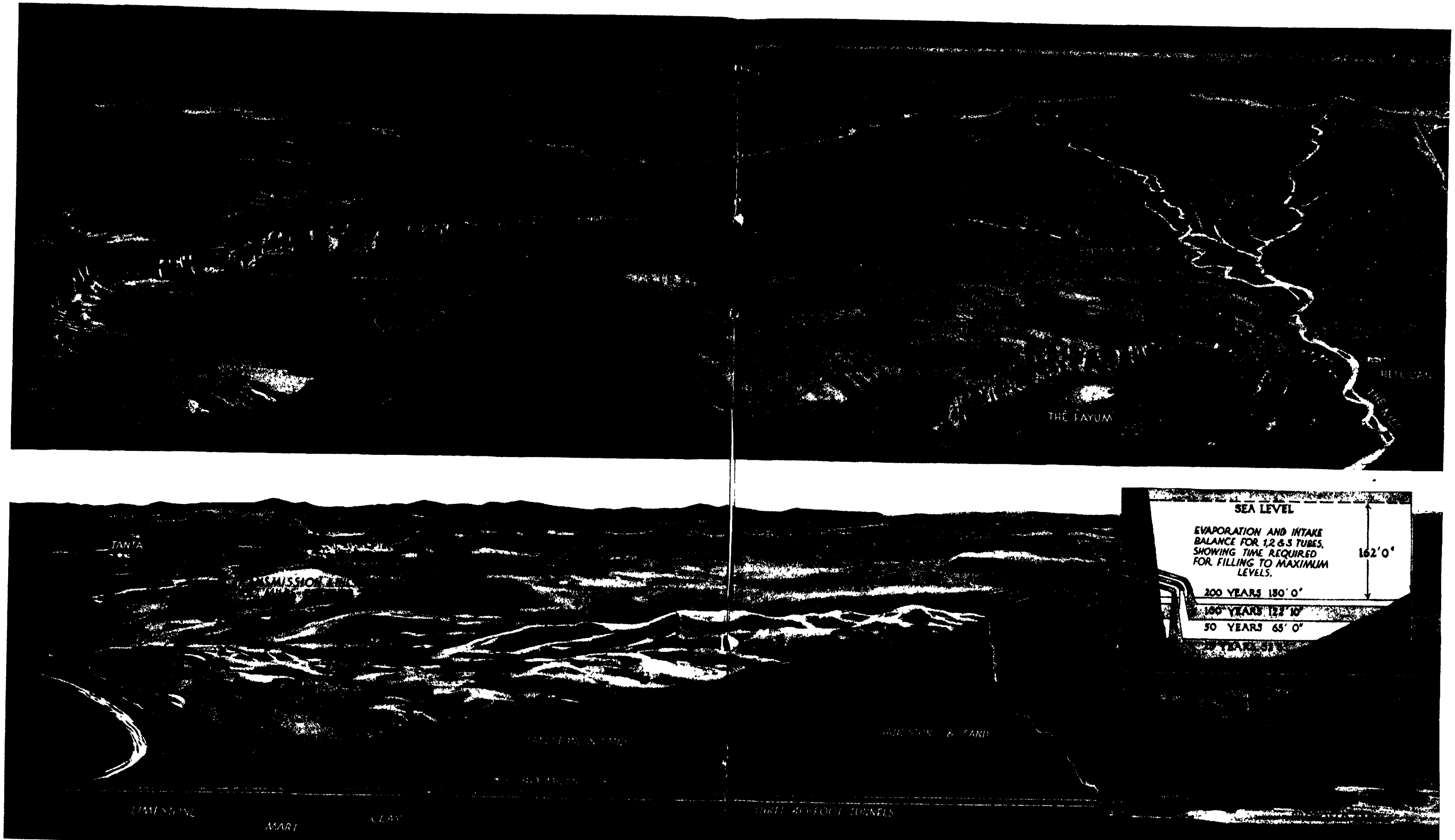
Again trials were made on root tips, paramecia, snails, hermit crabs, marine worms, and the like. In every case cell division was stopped. Hence one and the same organic compound in the body could stimulate or it could retard cell division or proliferation, depending on the state of oxidation of the sulfur it contained. Such a compound was the amino acid, the only one containing sulfur, called cysteine, and its oxidized form called cystine. But it is very hard to discover organic compounds that contain only partially oxidized sulfur derivatives, for natural, readily soluble, non-poisonous compounds are needed. Work was undertaken to prepare a compound half way between cysteine and cystine, but the process was endlessly difficult. It will be long before sufficient is available for further experimental work.

Even with the finding that cell proliferation can be controlled at will, this does not mean that cancers can likewise be controlled. The partly oxidized compounds must somehow be gotten into direct contact with the tissue in which the cells are dividing, before they can perform their work. The compounds so far known are unstable and, if injected or taken by mouth, would disintegrate long before they reached the malignant tumor.

BUT a solid foundation has been placed upon which others may perhaps build, long after Dr. Hammett's time. For one thing, cancer is not alone a matter of riotous cells madly dividing and proliferating. There is another biological disturbance here. For cancer cells have the virtue of perpetual youth. They do not mature as do normal cells. They do not grow up and become usefully functioning parts of the body. They grow wildly and heedlessly, like all young things, and obstreperously defy restraint.

So, even if the proliferation of these wild young cells could be retarded, cancer would not thus be cured. The evil would merely be held in check until the time it could manage to get the better of its host and, in killing that host, likewise achieve its own suicide. Hence scientists must search also for the naturally occurring substances that make body cells grow old—that make them lose their adolescent characteristics and their unrestrained tendency to reproduction. That chemical substance must be found which will restrain them regardless of their location, age them, and compel them to organize themselves for the performance of useful functions.

That is the present problem. It is a long and a tedious job.



Courtesy The Illustrated London News

Water Power and Salt Lake for Egypt?

IN recent years engineers have worked out plans, at least theoretically feasible, for utilizing the waters of the Mediterranean in stupendous engineering schemes. One of these contemplated construction of a canal somewhere in northern Algiers—it memory serves correctly—to carry Mediterranean waters inland to a depression in the desert. Rapid evaporation under the desert sun was to create a humid atmosphere which would result in sufficient rain in that region to reclaim a large part of the desert. Another scheme called for a dam at the Strait of Gibraltar and the installation of a huge power plant to be run by the flow of the water from the Atlantic as the level of the Mediterranean drops due to very high evaporation over the great area of this Sea.

The latest plan of this sort, depicted above, consists of a suggested hydro-electric power scheme for lower Egypt which would involve bringing the waters of the Mediterranean by canal and tunnel into the Libyan Desert. A vast salt water lake would thus be formed in an area that averages 195 feet below sea level and that has a total area of 19,500 square kilometers. The ocean water, brought a distance of 40 miles, would pass through turbines to generate electric power for use in the Delta. The lake would never actually fill up because of the rapid rate of evaporation which has been carefully calculated, consequently there would be a continuous flow of water to drive the turbines.

This idea which was first originated about six years ago by Dr. John Ball, Director of the Desert Surveys of Egypt, would render Egypt independent of imported fuel for irrigation and drainage; for running railways, trams, and factories; for illuminating towns; and for reclamation of waste lands.

THE LENGTH OF

By DONALD A. LAIRD, Ph.D., Sci. D., F.R.S.A.

Director, Colgate University Psychological Laboratory
Hamilton, New York

DR. STANLEY PORETUS recently brought back from his mental studies of the aborigines of Australia—living Neolithic men—amazing accounts of tests of the skill of these primitive people in tracking others, just as a dog follows a trail. Less qualified observers have brought back similar stories from their travels to secluded parts of our whirling sphere, and it has been difficult for many people to believe that mankind actually had a sense of smell that would respond to anything other than a pleasant perfume or an overwhelming stench.

Scientific studies which have just

Sir Francis Galton, who could use smells as symbols for numbers and do arithmetic by means of them! Camphor—1, jasmine—3, and so on

been completed show, however, that an astonishing proportion of persons in the most civilized parts of the globe can actually do remarkable things with their sense of smell. Two hundred and fifty-four Americans who are well-known and highly accomplished, co-operated with Harvey Braden Fitz Gerald in the Colgate psychological laboratory in these studies which revealed, among many other interesting things, that our modern sense of smell is acute and capable of phenomenal practical discriminations.

It is not just the nose of the savage that is capable of tracking persons and animals by scent. We found that nearly 10 percent of our highly civilized subjects could do almost the same thing, and with great accuracy. What is more, they were habitually tracking people and things with their nostrils. We do not know how many more could have readily learned how to use their sense of smell in this keen fashion if they had only been given the necessity for cultivating this use. The savage has, of course, had to depend largely upon his sense of smell, while few civilized people have to depend so entirely upon this racially-old sense.

The city dweller, for instance, watches for careening automobile headlights coming down the street toward him; he does not pay attention to the odor of alcohol which might inform him that there was a drunken driver in his vicinity. But, in spite of this apparent neglect of odors every day, the sense of smell still retains a vastly greater acuity than 99 percent of people would ever dream possible to have.

Once one has to make some use of his nose, then he comes to realize that this apparently unused sense is most certainly not an idle sense. Ellis Parker Butler, for instance, tells us: "I am peculiarly sensitive to odors. Because of an illness in her youth my mother had no sense of smell, and as I was the eldest child I was continually asked 'Do you smell anything?' My nose had to do double duty and I suppose its keenness was increased."

BUT our large number of records show plainly that such extra incentives are not needed for one to make astounding use of the olfactory sense. A few people, of course, can be recognized by their own individual and characteristic odor, but have you realized that most people can be recognized by their "nose prints"?

"I often know whether a person has been in a room within the past hour or so by the odor," Dr. Bruce V. Moore the psychologist reported to us. "Often I can tell to whom an article of clothing belongs by the odor, even though in both cases the persons are cleanly about their person."

One woman, whom we will not mention by name, told us: "I can locate people by their perfume, and my good husband has found it embarrassing when I tell him where he has been by the odor he has retained on his clothes or skin." Under those circumstances, we can safely bet that her husband has to be "good."

Ann Hard, whose Washington broadcasts have a large following, may have a literal foundation for her nose for news, for she tells that "as a child I used to amuse myself by recognizing various people with my eyes shut, purely by the sense of smell. I have always enjoyed trying to analyze the ingredients in a nasal impression, much as I enjoy placing the instruments in an orchestra of men or of insects or of birds."

Dorothy A. Wayman, the author of "An Immigrant in Japan," informs us that she distinguishes " 'racial' scents—while Americans, Portuguese, Negroes, Scandinavians to me have personal odor—aside from uncleanly smell, be it understood. Many Japanese have told me all foreigners have a disagreeable odor to their sense of smell. Orientals to me, have a characteristic, not unpleasant, odor that clings to silks, jades, and other materials they have handled."

A retired army ordnance officer reports: "As a boy I was occasionally allowed to spend the night with some playmate. I was in several instances impressed with the 'family odor' which later I detected every time I came in the presence of any member of that family. In one case I have sensed this odor even in the third generation—long years afterward."

"Houses have definite scents for me," the wife of a trustee of Brown University tells us. "I recall even the smell of the houses of some of my grandmother's

Ill humor may give off an odor of its own. Accordingly in a prison, might a keen olfactory sense not smell out a riot before it came?

Your Nose

friends. Foreign cities have vivid scents for me—the smell of Paris is a maple-like scent blended with wood smoke. London smells damp—with a flavor of old box. Spain smells like a mixture of orange blooms and boxwood in the sun, which always makes me feel romantic." In view of the last phrase, we are considerately leaving this interesting account unnamed.

Roy Mason finds: "Odors have always seemed to me to be definitely associated with households. I have a cousin whose house always smells just as his mother's house used to smell."

Many physicians use their sense of smell to aid them in the diagnosis of disease, not merely in detecting instantly on entering a room the presence of pus or putrefactive processes, but the sweet odor of the breath of a diabetic, the vinegar-like breath or buttery smell of the skin in uremic poisoning, or the well-cooked sauerkraut smell in diphtheria. One surgeon tells us: "I use my nose to some extent in determining the condition of surgical wounds, as to whether we have a normal serious outflow or whether there are putrefactive processes at work. I can recognize the presence of certain organisms by their characteristic smell."

A FOOD chemist has raised an interesting question along this line. "Is there an odor characteristic of a mood or temper of people?" he asks. "Does anger cause an individual to throw off a certain odor; does fear; does dejection? I have been through a number of prisons and detention homes, and have noticed an odor in each different from the others and seemingly characteristic of the mood or temper of the inmates."

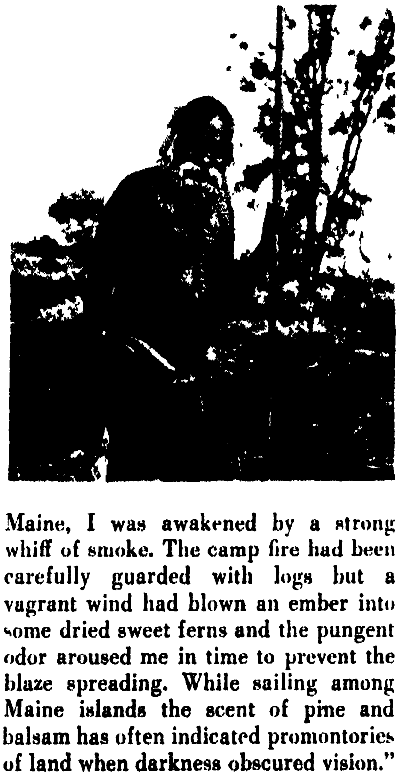
Places, as well as people, have their characteristic aromas which the untrained nose of highly civilized persons can detect. We even discovered an interesting small social group in California that breaks the tedium of automobiling with a blindfold game in which they try to recognize places they are passing along the highway by the odor.

Margaret Fuller, author of "Her Son," writes us: "Driving, even with my eyes shut, I can smell the newly ploughed fields, the bog, marsh; I can usually tell the trees by smell—of course flowers, some insects, most animals, different woods, in fact everything, more or less. I can smell smoke in the woods when I cannot see it—that is, when a faint trail is brought on the wind.

"My sister," she continues, "this instant stepped to the door sill and remarked, 'Funny, but I seem to smell smoke!' My sister Louise said, 'That's all right—I simply lifted up and put down again a pail that had ashes in it from the open fire.' "

And Ann Hard says "there are certain regional variations in natural odor—country odor—which I believe I feel so keenly that I would almost know with my eyes bandaged where I was in the summer time."

Rex Brasher, the painter of more than 3300 bird plates, throws light on how keenly alive our noses are even while we are asleep. "One night about 2 A.M.," he says, "while asleep in a camp in



Maine, I was awakened by a strong whiff of smoke. The camp fire had been carefully guarded with logs but a vagrant wind had blown an ember into some dried sweet ferns and the pungent odor aroused me in time to prevent the blaze spreading. While sailing among Maine islands the scent of pine and balsam has often indicated promontories of land when darkness obscured vision."

Not only skill in blind navigation can be better understood by a realization of this subtle keenness of the sense of smell, but even our passing moods may be related to this, at times, unconscious acuity. Our noses, apparently, are eternally sniffing, whether we are conscious of it or not; yet these often fleeting olfactory stimuli—which we may never consciously note—can still leave their mark and alter our entire train of thought. Take the following, for example, which came from the principal of a girls' finishing school:

"On the train once, in the midst of happy conditions, I suddenly felt discouraged, awkward, unhappy. As soon as I recognized the perfume used by a fellow traveler, I saw very vividly a large dancing class, a French dancing master, and felt again my girlish dismay at his attitude toward my poor attempts to learn the steps he was trying to teach me. As soon as the memory-picture came I knew why I had suddenly felt unhappy, and, of course, came back to normal, and this experience occurred some 15

Australian aborigines are noted for their ability to track down a man, using a combination of keen observation and olfactory sense

or 20 years after the last time I had seen the dancing master."

The sense of smell is obviously still an active, keen, living sense, even with the failure of most of us to cultivate it. There is doubt that savages have keener noses—they have simply learned better how to make most use of the first cranial nerve, just as the blind do not have more sensitive ears than seeing persons, but have learned how to listen and thus discover obstructions.

A little rumaging among our thoughts, or attempts to sense hitherto unperceived odors, may provide surprising revelations of our own savage sensitivity to scents. The psychologist, Professor F. Kiesow, has recently shown that tastes and smells play a large part in dreams.

Keen as our sense of smell has remained through thousands of centuries, it is fortunate that many manufacturers are now using perfume materials to make otherwise unpleasant products smell clean and respectable—fortunate for the manufacturers as well as for the customers. If only a few individuals would take a suggestion from these manufacturers!

Remember—nose rubbing is more widely used as a greeting than are hand-shaking and kissing, combined.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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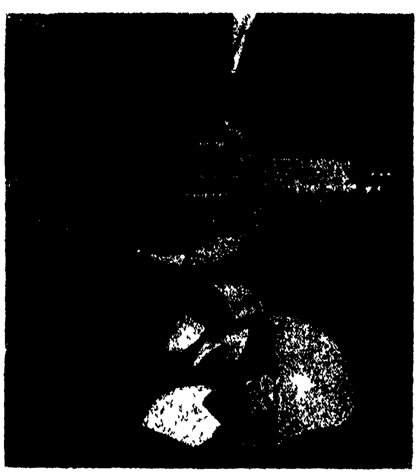
Lamp Filament a Coiled Wire

WHAT looks like an ordinary piece of wire in a 40-watt G-E Mazda lamp is actually a coiled filament resembling a spring. This piece of wire, apparently but 1½ inches long and scarcely visible, is 14½ inches long, coiled 460 turns to the inch. The wire, finer than a human hair, is but a thousandth of an inch in diameter. Being coiled, the filament is more rigid and can withstand the tremendous heat of 4400 degrees, Fahrenheit.



Magnifying glass shows the coiled wire filament of a 40-watt lamp

X Ray Diagnoses Elephant's Arthritis

TOO many peanuts and not enough hay and other roughage proved to be a bad policy for Nizie, a highly trained dwarf elephant. The elephant's part in the performance of Nicola the Magician consists of a disappearing act, requiring some agility, and when his left foreleg stiffened up for no apparent reason, the veterinarian was at a loss to know what treatment to prescribe. The situation seemed to call for an X-ray examination, but even a dwarf elephant is a little bulky for hospitalization.

Engineers of the General Electric X-Ray Corporation had solved a similar problem for C. V. Whitney's famous horse, Equipoise. Armed with a newly developed small portable shock-proof outfit, they paid a visit to the elephant's stall. Whereas it took but five seconds to make an exposure of Equipoise's leg, the thick elephant hide required 45 seconds, during which time Nizie was kept in place by chains and promises. The X ray recorded every detail of stiffened joints and bone formation, and a verdict of arthritis, or rheumatism, was handed down by Dr. F. M. Kent, together with a prescription for a change in diet.

Nizie's pain is diagnosed by means of portable X-ray equipment

Flaked Coffee

BARRAGES of ballyhoo have made something of a national issue of the relative "freshness" of various brands of coffee. One claims that the only way to guarantee freshness is to deliver the coffee promptly from the roaster to the consumer. Others rely on hermetically sealed containers to preserve the flavor. Still another school recommends buying whole-bean coffee and having it ground just before using. Now a new wrinkle appears on the horizon—flaked coffee, packed in carbon dioxide gas—which is said to keep "fresh" for a couple of years and to produce a better brew from less coffee.

Research workers at the Mellon Institute of Industrial Research who developed flaked coffee have made a thorough study of the changes that take place in ground coffee as it ages. While green coffee may be kept for long periods of time if protected from mold and bacterial growth, roasted coffee immediately begins a gradual deterioration that is more rapid when it is ground. Coffee aroma is a complex mixture of volatile compounds formed by pyrolysis of the components of the green coffee bean. The soluble non-volatile principles of the bean likewise undergo pyrolysis, resulting in the production of caramel-like substances that give body to the brew prepared from the roasted coffee. Coffee also contains a fatty oil that undergoes some alteration during roasting.

The changes that produce stale coffee are, in decreasing order of importance, volatilization of aroma, oxidation of aroma, and oxidation or rancidity of the coffee oil. During the roasting of coffee there is a

copious production of gas in which carbon dioxide predominates. In addition to the gas that escapes during roasting, a considerable portion is retained in the roasted bean by occlusion. Ground freshly roasted coffee contains approximately five times its volume of this gas, which slowly departs as the coffee ages, sweeping out a large proportion of the aroma. When attempts are made to preserve the freshly roasted coffee by immediate hermetic sealing, the accumulating gas produces such a pressure as to rupture the container unless one of special strength is provided. If, on the other hand, the container is vacuumized, the occluded gas is by no means completely removed during the operation, permitting the building-up of some gas pressure within the container, which escapes upon opening the container, carrying with it at the same time the aroma with which it has become saturated.

Produced by passing ground freshly roasted coffee through a roller mill under high pressure, the coffee flakes have about 90 percent of the occluded gas expelled from them with practically no loss in aroma. And in this form, coffee has been kept fresh two years by sealing in carbon dioxide. As they come from the mill, the flakes are thin and flat, averaging about 0.06 in. in diameter and having a thickness of approximately 0.003 in. This flaking operation makes the soluble constituents of the coffee instantly accessible to the extracting liquid, and extraction not only is more rapid but it is also more uniform and complete. The flakes are said to yield approximately 50 percent more extractive than the customary drip grind and from 75 to 100 percent more than the ordinary percolator grind.

The research leading to the production of the new flaked coffee culminates from a broad study of the packaging of coffee begun in 1929 under the Can Fellowship sustained by Continental Can Company, Inc., New York. Patents cover the process.—*A. E. B.*

Non-Fouling Spark Plugs

AUTOMATIC cleaning of spark plugs has been developed and patented by a German chemist, H. Narratiel, according to *Chemical and Metallurgical Engineering.* The cleaning is accomplished by providing catalytic surfaces to prevent deposition of carbon at all points which come in contact with the combustion products. These surfaces consist of metals of the earth or rare earth groups, or metal oxides, such as copper oxide.—*A. E. B.*

Cabalistic symbols of the chemist's art are a thing of the past, but a New York City photographer, Stella F. Simon, has found striking decorative values in the glassware of the modern chemist. From photographic studies of funnels and flasks, retorts and mortars, she has produced unusually attractive window shades. Strips of shade material were coated with sensitized emulsion on which the enlargements were made, and developed and fixed in the regular manner. After a year of use, the photographs show no signs of cracking. The two upper illustrations show the unique designs, and the lower one the shades in use.—*A. E. B.*

Dangerous New Reducing Drugs

THE danger as well as the usefulness of certain new reducing medicines, among them sodium dinitrophenol, were vividly pictured by Dr. Edward L. Bortz of Philadelphia at a meeting of the American College of Physicians.

So dangerous are these medicines if carelessly used that an eminent jurist urged Dr. Bortz to recommend their inclusion in the list of dangerous drugs whose use is governed by the Food and Drugs Act.

Three deaths have been reported in medical journals from the use of dinitrophenol, according to Dr. Bortz. In every one of these cases and in certain others, not fatal but in which other untoward effects occurred, the dosage was too strong or the drug was not correctly given.

"One wonders how high the toll of deaths is going to mount when the beauty parlors and physical culture emporiums begin to pass it around," Dr. Bortz commented.

Sodium dinitrophenol and allied drugs were described by Dr. Bortz as accelerants of metabolism, the change whereby foodstuffs, water, and air are adapted to the needs of the body for growth, maintenance, and repair and the production of energy. This change is accompanied by heat production. When metabolism is speeded up,

under the influence of dinitrophenol, for example, more heat is produced, the surplus fat of the obese person's body furnishing the additional fuel. This results in the desired loss of weight.

With overdosage of the drug, heat is generated faster than needed and faster than the heat regulating center of the body is able to dissipate it through stimulation of the respiratory apparatus and sweat glands. The body temperature rises, up to 115 degrees Fahrenheit or higher, and death occurs from heat rigor. The body almost literally burns itself up. This was the fate of the unlucky victims of overdosage of dinitrophenol. To protect others from a similar fate, Dr. Bortz believes sale of this drug should be regulated so that it can only be used under a physician's directions.—*Science Service.*

Boulder Dam Generators

WHEN the waters impounded behind Boulder Dam are finally turned through the Boulder power station, the world's largest hydroelectric generators to date, born in the General Electric shops at

One of the huge stator frames to be used in a generator at Boulder Dam

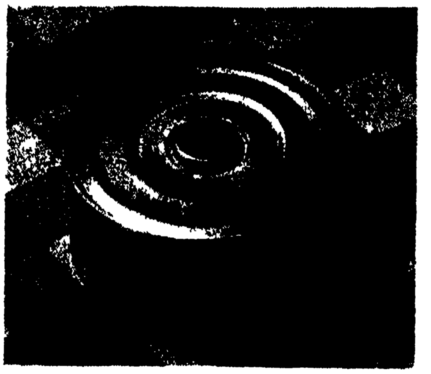
Schenectady, will convert the mighty power of the Colorado River into electricity for transmission to Los Angeles, 265 miles away.

The photograph shows just the stator frame for the first of these huge machines, rated at 82,500 kilovolt-amperes. The complete generator will be 40 feet in diameter, 32 feet high (above the floor), and will weigh over 2,000,000 pounds. Disassembled into sections small enough to be shipped by rail, at least 40 freight cars will be necessary for the transportation of each generator to Boulder Dam.

Canned Cheese

THE age-old method of making natural American or cheddar cheese in gigantic loaves weighing as much as 70 pounds may be revolutionized by a new method of canning natural cheese just perfected by the Department of Agriculture. It employs a new kind of can which is round in shape to hold 12 ounces or more, enamelled inside, and equipped with a valve in the top which permits readily the escape of the natural carbon dioxide gas thrown off by the cheese during the maturing period, but prevents ingress of air.

At the beginning of the process the new method of making cheese in cans does not vary much from the old. Fresh milk is given the right acidity by adding a minute portion of soured milk or culture to act as a starter and give the right degree of acidity. Brought to 86 degrees, Fahrenheit, a few ounces of rennet is added to each ton of milk,



New can for cheese, with a one-way "flap" valve in center of the top

which causes it to curdle and coagulate within 40 minutes. The curd is then sliced and cubed by hand knives, and allowed to cook a few minutes at a temperature of 100 degrees, Fahrenheit. The whey or liquid is drained off, and the curd then chopped into minute particles. After the addition of salt it is pressed into print forms in sizes from ten to seventy pounds, remaining in the press about 24 hours.

At this point in the old method the loaves are bandaged with cheese cloth and stored at 70 degrees, Fahrenheit, for a week or more, then coated with paraffin and allowed to mature in a cold room at about 50 degrees, Fahrenheit, for four months, being turned daily so that the maturing process will be even throughout the loaf. A shrinkage in excess of 5 percent invariably occurs in the process, and rind formation and surface hardening later cause further wastage. The loaves are boxed before shipment.

In the new canning method, after the curd is finally pressed, it is cut into the required size and weight, each piece rolled in Cellophane and sealed into the valve-vented can, ready for shipment after the four months curing period. No shrinkage occurs. The cheese has no rind, and each package is like a fresh cut from the center of one of the large loaves.

Scientists of the Department of Agriculture and of the Continental Can Company spent three years in perfecting the valve-vented can and the new method of canning cheese.

Reports New Cure of Tetany

TETANY, the severe nervous and muscular disease featured by painful muscular cramps and caused by an insufficiency of calcium in the blood, can now be cured or greatly relieved without delay, even in the worst cases. Tetany should be distinguished from tetanus, or lockjaw.

The new treatment, described by Dr. I. Snapper, professor of medicine and general pathology in the University of Amsterdam, in *The Lancet*, medical journal published in England, is the giving of a substance known as "A.T. 10."

"A.T. 10" is a fraction of the well-known irradiated ergosterol which is rich in vitamin D. Prolonged dosage with ordinary irradiated ergosterol, in conjunction with oral doses or injections of calcium, has previously been used as a treatment for tetany. Though in some cases it was fairly successful, in others disagreeable and even dangerous symptoms were produced. From "A.T. 10," however, the vitamin D is absent, and there are no unwanted symptoms provided that the doses are stopped as soon as the blood's calcium content has been brought to normal. This is usually achieved within a comparatively few days.—*Science Service.*

Potash Mineral in Kansas

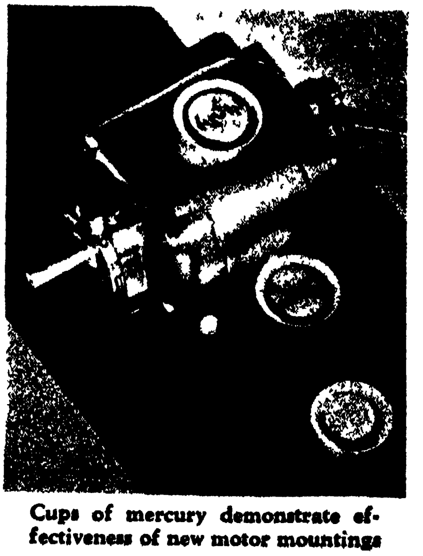
THE United States Geological Survey has announced the discovery and identification of the potash mineral polyhalite in a sample of well cuttings from western Kansas. This is the first recognition of this mineral in that state. F. C. Calkins and R. K. Bailey of the Geological Survey staff found it in cuttings submitted by the Central Commercial Oil Company. The cuttings came from a well in Trego County about four miles south of Riga, from a depth of about 2000 feet, which in that locality is approximately sea level. The polyhalite made up only about 5 percent of the sample and hence has no commercial interest in itself, but the discovery suggests that further exploration in Kansas might lead to the discovery of richer bodies of potash salts of possible commercial value. The finding and identification of polyhalite in cuttings from an oil well in Texas was the first step leading to the development of the present potash industry in New Mexico.

Salt deposits have long been known in eastern Kansas, but the salt is practically free of potash. Very small percentages of potassium, however, have been reported in some mineral waters of the state.—*A. E. B.*

Rubber Motor Mounting Proved Effective

THE effectiveness in damping out vibrations, of the rubber mountings used by General Electric on its latest appliance motors, is shown graphically by three little pools of mercury.

Two of the shallow cups containing the mercury are secured to the motor itself.



Cups of mercury demonstrate effectiveness of new motor mountings

The third mercury cup is fastened to the board to which the motor is bolted. In the two upper cups, there is visual evidence of the slight vibration inherent in the motor, but the lowest cup shows that none of this is transmitted to the support to which the motor is attached.

If the rubber cushioning is "short-circuited" by jamming a screw-driver or other object between an end-shield and the supporting cradle, the pool on the board will immediately show vibrations of a magnitude equal to those seen in the two pools on the motor.

Four Dozen Teaspoons in a Woman's Stomach

RIPLEY might say "Believe It Or Not" but the records of the State Hospital at Central Islip, New York, show that from the stomach of a woman recently admitted there suffering from melancholia with suicidal tendencies, there were extracted 48 teaspoons, 1 teaspoon handle, 3 bolts, 1 prune pit, 1 nut, 1 small piece of glass, 1 button, 2 pieces of spring wire, 1 needle, 1 piece of cinder, 1 hairpin, and 1 lead pencil. John Hix might say "Strange As It Seems" but the hospital records show that the patient recovered.

Type Without Type

OLD readers of SCIENTIFIC AMERICAN will remember that during the printers' strike early in the 1920's a makeshift method of producing the magazine was used in which typewriting and longhand manuscripts were reproduced by an engraving process and used for making up the magazine. Although not anticipating another printers' strike which would make it impossible to have type set in the ordinary manner, a new invention makes possible the production of perfectly aligned type matter with an ordinary typewriter. A sample of work so produced is shown in these columns, reproduced by the half-tone process.

This system of obtaining "type without type," invented by Joseph SpielVogel, uses a sheet of finely corrugated paper having horizontal parallel slits at intervals equal to the distance between lines on the typewriter, which paper is cemented to a backing sheet. The typist writes the manuscript on the corrugated side between the slits in the conventional manner, without any effort at alignment. The copy is aligned at the right-hand margin after it is taken out of the machine by lifting the ends of the lines from the backing sheet, stretching them to the required uniform width, and then reattaching them. The special cement used remains permanently plastic.

There is no apparent distortion of characters when the lines are stretched because

produced with the patented paper. Distortion can be positively controlled in any direction. Startling illustrative effects may also be secured in this easy way.

Another feature of Mr.SpielVogel's invention makes it possible to get various sizes and styles of type on the ordinary typewriter, by simply typing on his patented paper and then stretching it to the desired size or shape. The following are a few examples of types produced with the regular typewriter keyboard:

Vogel-Type Condensed
Vogel-Type Italic
Vogel-Type Extended

Justified (aligned at right) typewriting obtained with special paper

the spaces between each letter and word are enlarged proportionately. Copy of this kind, after it is aligned, can be reproduced in any one of several manners. As shown in the accompanying illustration, special features can also be obtained from ordinary typewriting.

Flakes of Aluminum

HOW thin is a flake of aluminum bronze powder? This question, an important one in the paint industry, has been answered by Aluminum Research Laboratories, New Kensington, Pennsylvania. In average size, such a flake of powder is not much thicker than the wall of a soap bubble. It would take more than 100 flakes, laid one on top of another, to make a pile which would reach as high as the thickness of the paper on which this article is printed.

When aluminum became commercially available, its powder was known as "aluminum bronze powder," which is a misnomer because it is not a bronze. It has an aluminum purity content of more than 99 percent and is used as the pigment portion of aluminum paint. It is different from other pigments, in that the individual particles are flaky instead of granular.

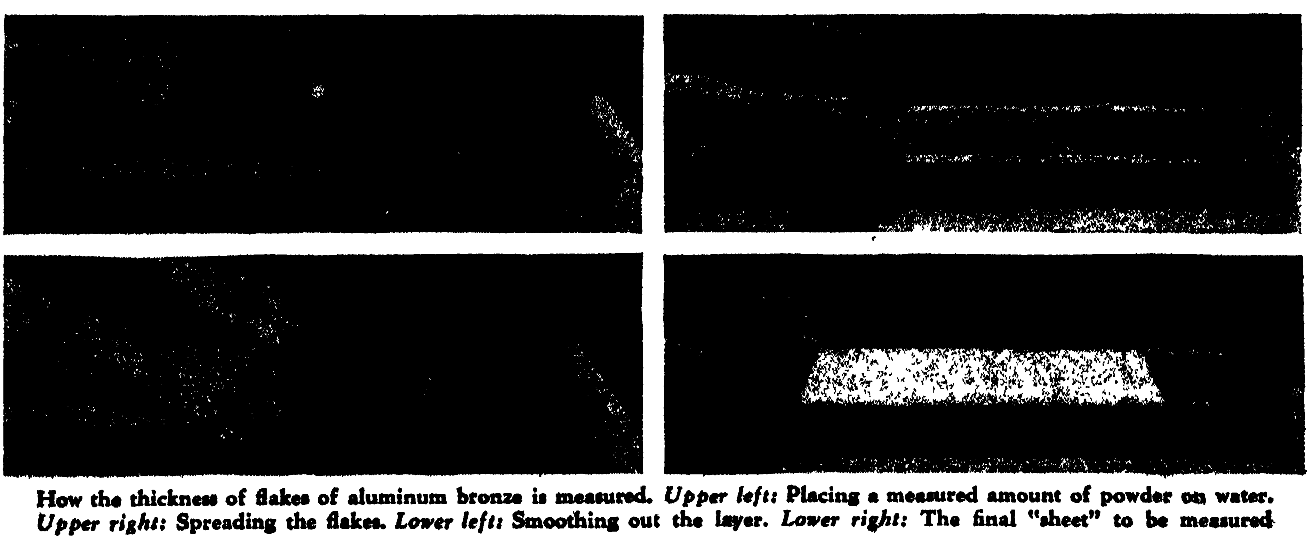
The effectiveness of aluminum paint as a protective covering for surfaces outdoors and in, comes from the minute metal flakes, impervious to light and moisture. The microscope reveals the fact that the flakes overlap in layers in the dried paint film, actually forming, in effect, a very thin layer of metal over the painted article.

Thick flakes affect the leafing characteristics of the powder and the covering quality of the paint. It is therefore important that the flake thickness be controlled in manufacturing processes. But how can these infinitesimal particles be measured?

The measurement of flake thickness is peculiarly difficult because the aluminum flakes are too small to handle, even under the microscope. An ingenious method has been devised, however, which requires as measuring instruments only a balance and a common ruler or yardstick. In using this method, Assistant Director of Research Junius D. Edwards and Dr. Ralph B. Mason, of Aluminum Research Laboratories, employed a flat-rimmed, shallow, rectangular pan filled with water to just above the brim, surface tension keeping the water from overflowing. Two flat strips of glass, each an inch or so wider than the pan, were laid on the rim across each end to act as barriers and to help "coax" the powder into the desired film, one flake thick.

Windows are closed and doors are shut, for the room in which the measurements are taken must be draft-free. An accurately weighed sample of powder—one tenth of a gram, for convenience—is dusted from a small container onto the water surface. The flakes, only partially wet, float upon the surface. One of the glass plates is pushed towards the other, sweeping the floating powder before it for about two thirds the length of the pan. Then the glass is pulled back again. This pushing and pulling operation is repeated until the powder film is uniformly smooth. The film of powder wrinkles much like a piece of cloth, when the flakes are all touching and are further compressed by the pushing of the glass plate.

The barriers are then adjusted just sufficiently to eliminate the wrinkles, and the powder film becomes absolutely uniform. The length and width of the film are then



How the thickness of flakes of aluminum bronze is measured. *Upper left:* Placing a measured amount of powder on water. *Upper right:* Spreading the flakes. *Lower left:* Smoothing out the layer. *Lower right:* The final "sheet" to be measured

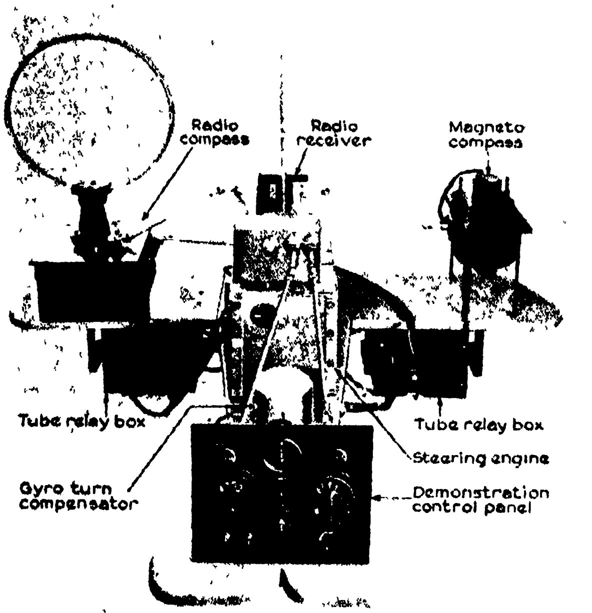
measured with the ruler and the area which one gram of powder will cover is calculated. From the area and volume (which is calculated from the density—2.5 grams per cubic centimeter) the thickness is simply calculated. The results of such calculations show the average thickness of flake to vary from about .00005 to .000012 of an inch with different grades of powder.

Automatic Steering Control for Airplanes

EXPERIMENTS in "Radio Aids to Air Navigation" have recently been described before the American Institute of Electrical Engineers by Dr. C. F. Green and H. I. Becker, of the General Electric Company. They have developed a system by means of which it is hoped to achieve completely automatic steering of a plane, the plane is thus steered to right or left.

The flexibility of this system permits three different methods of automatic steering to be employed. First, automatic steering by magneto compass; second, automatic steering by radio compass; third, full automatic steering with automatic drift correction by radio.

In the first method the pilot sets the magneto compass to the correct bearing for the point towards which he desires to fly. After taking off, the plane is headed in the approximate direction of the objective. The pilot switches on the automatic system, which takes control of the rudder and steers the plane on the selected course. The magneto compass is the heart of this system. As soon as the plane starts to deviate from its correct heading, the magneto compass begins to generate electricity. This current operates a relay, which, through



Photograph showing the essential parts of the new automatic steering control for airplanes described in these columns. With this system, which is still in the experimental stage, it is hoped to reach completely automatic steering. Drift caused by wind, which has been one of the major difficulties of such automatic steering, is to be overcome by the use of the radio compass

utilizing radio for the purpose of correcting wind drift. The principal components of this system, as shown in the photograph, are: Magneto compass, turn compensator, radio compass, steering and loop engines, course setter, and radio receiver.

The motor-driven magneto compass can be mounted at any point in the fuselage, preferably at its tail, where it is least effected by the magnetic properties of the airplane structure and equipment. A motor-driven turn compensator corrects for the north-turning error, which is present in all magnetic compasses.

The purpose of the radio compass is to determine whether or not the plane is flying directly towards a radio transmitting station. This information may be visibly obtained from a zero-center right-and-left reading meter. If automatic operation is desired, the current to the meter may be used through associated apparatus to move the rudder of the plane to right or left and thus maintain the desired heading.

The steering and loop engines are combined in a single-unit construction and driven by a dynamotor. Electrically operated clutches, when energized, permit the rotation through any desired angle of the compass and loop simultaneously, or of the compass alone. Connection is also made from this unit to the rudder cables, and amplifiers in a control box, energizes the motor-driven steering engine and corrects the rudder position. If a cross-wind is blowing, the pilot must watch his landmarks and make corrections in the compass setting, until he is following the desired flight path.

In the second method there is automatic steering by radio. When the radio compass loop is normal to the radio waves, there will be no current flowing in the radio compass circuit. If the plane deviates from the line of flight, a polarized current flows in the compass output circuit. Then by means of a relay and auxiliary tube circuits, the steering engine is actuated and the rudder is again brought into play. In practical operation, the pilot, by means of the course setter, turns the loop until it is at right angles to the long axis of the plane. After taking off he flies in the approximate direction of the desired radio station and engages the automatic control. The radio compass and its controls now keep the plane always pointing towards the broadcasting or beacon station, and while a cross-wind may drift the plane from a direct line of flight, it will be brought back over the transmitting station.

The third system involves automatic drift correction by radio. In this system the desired course angle, using the magnetic north as a reference point, is used as a basis for establishing the relative positions of the magneto compass and the radio loop. This relation then remains fixed and the radio compass controls the rudder. Current from the magneto compass, due to deviation to the right or left, causes a simultaneous rotation of both compass and loop until the poles of the compass are again pointing east and west and no more current is flowing.

When the plane tends to drift from its course due to a cross-wind, the loop ceases to be normal to the radio waves from the station towards which it is flying, and current starts to flow from the radio compass. This operates the steering engine and the rudder comes into action, bringing the plane back toward its correct flight path. This movement, however, changes the position of the magneto compass poles with reference to their original east and west position, and now the compass comes into action, and both the compass and the loop are simultaneously rotated until the compass poles are again east and west.

The plane is now not pointing directly toward the radio station, but is headed into the cross-wind at an angle to correct for the drift. It will maintain this position on its original course as long as the intensity of the wind remains the same. Any increase or decrease in wind velocity will be automatically compensated for, and the plane will continue to fly on the direct course to its destination. This is specially important for night operations, for flying through clouds, in thick weather, or over areas where no landmarks are visible.

The effective range of this control equipment is only 150 miles and it is not yet completely developed.—*A. K.*

When the Motor Drops Out

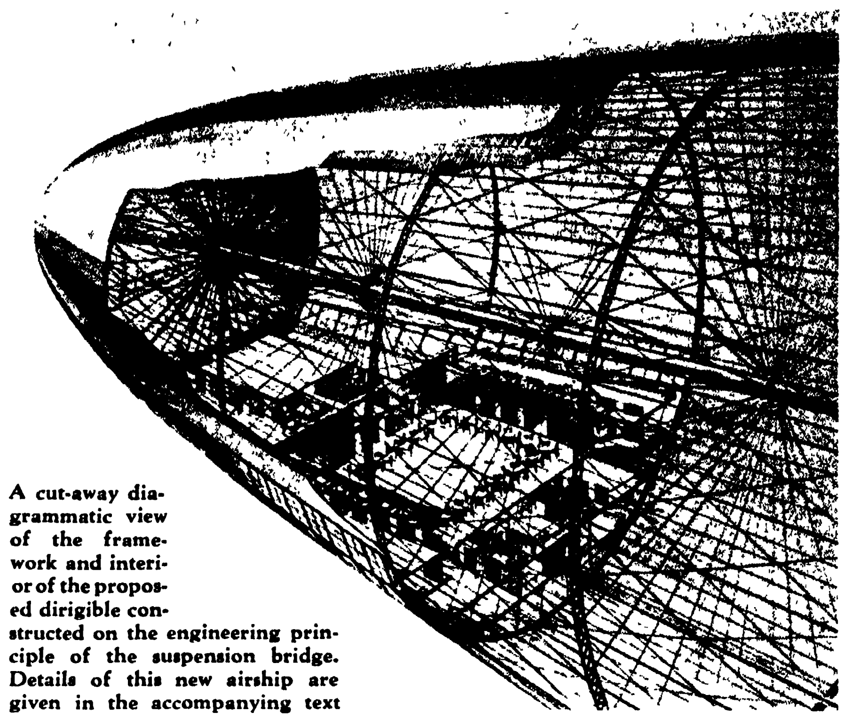
THE following paragraphs are taken from a terse report by a pilot who heard a rending crash, found his head down to his knees, his eyes closed, and his ship whipped up into a vertical climb, as the motor dropped out of the nose of the ship.

"I could not open my eyes for the moment and first reaction was to shut off valve. This and releasing hatch was done before I could straighten up. As soon as the hatch lifted and there was a rush of air into cockpit, full muscular control returned to body. My eyes opened and altimeter was first thing noted. The reading was 6500 feet. The ship had reached the peak of its climb and was falling off to right, went into half turn with tail down and right wing pointing down. I was loose in belt. Grabbed control stick and as ship picked up speed in falling, I felt pressure on controls. These soon took hold and I righted the ship into a dive. With heavy pressure on stick I rolled stabilizer all the way up (which did help). As I let stick back, nose came up and I found I had control of the ship. I unbuckled belt to jump when I thought—'I've righted a ship from inverted outside spin and I seem to have control of same with plenty of time to still jump. I'll just see what I can do in controlling ship in flight.' This I started to do. I soon found that with nose down too far the ship would rock in the forward motion. When I let nose come up too far with reduced speed ship fell off to right. This happened twice. I then noted that

best control was with the airspeed showing 110 M.P.H. This gave me directional control and all.

"I knew I had about a 20 mile north wind on ground and I noted just before motor tore off where an emergency field was. As I again looked around said field lay up ahead of me. I quickly made survey of fields south of same. Noted they were open and by this time I felt fully confident that I could land ship with better than 50-50 chance and not hurt self nor ship.

"The ship was now acting much the same as a glider that I had flown a few years ago. I rebuckled my belt determined to set ship down in the middle of the field. As I came nearer the ground and field I had to maneuver in figure 'S'. This I did with rudder only. Passed over road and fence about 20 feet high. At this point I depressed nose of ship a little more—leveled flat and held this till ship touched ground."



A cut-away diagrammatic view of the framework and interior of the proposed dirigible constructed on the engineering principle of the suspension bridge. Details of this new airship are given in the accompanying text

A "Suspension-Bridge" Airship

A NOVEL type of airship, designed by Mr. Roland B. Respess, has recently attracted much attention. Mr. Respess had in this project the valuable advice of Mr. Robert T. Pollock, consulting engineer and the American collaborator in designing and building the British airship *R-100.*

Prior to its submission to governmental authorities, the Respess airship was carefully studied and analyzed by a number of consulting engineers, whose findings were supported by a water model test at the Daniel Guggenheim School of Aeronautics.

In this airship the suspension bridge principle has been ingeniously employed. The structure consists primarily of a rigid central member in the form of a tube which extends from bow to stern. Attached to the central member are a series of transverse wheel-like frames between which the gas bags are mounted. The diameter of each frame is determined by the contour of the airship at its particular position.

Flexibly mounted on the transverse frames and connected with them are longitudinal steel wires which are continuous from bow to stern and are fastened to the ends of the central member. A similar set of wires are attached to the circumference frames at an angle and serve to take up the shear loads. The wires are of high strength steel suspension-bridge type, carefully tested and specially treated to resist corrosion.

The advantages claimed by the designer for this type of airship are as follows:

The airship will be somewhat more flexible than the conventional rigid frame airship and will therefore take up sudden gusts and loads with less danger and damage. This is because the strength lies mainly in the wires and cables which have more give than rigid members. Further, from an engineer's point of view, another advantage lies in the fact that the airship structure is entirely determined in that all members can be calculated by simple engineering principles. It is also hoped to attain a structure of lesser weight, which is important from the point of view of pay load, simplicity, and cost of construction.

The design submitted to the government presupposes a ship 147 feet in diameter and 785 feet in length. While its main purpose is for use in transatlantic service, provision has been made for gun installation and other steps for conversion to naval uses.

The plans call for the construction of two airships, a new type of hangar and establishment of a regular transatlantic service.—*A. K.*

Test Flights of the S-42

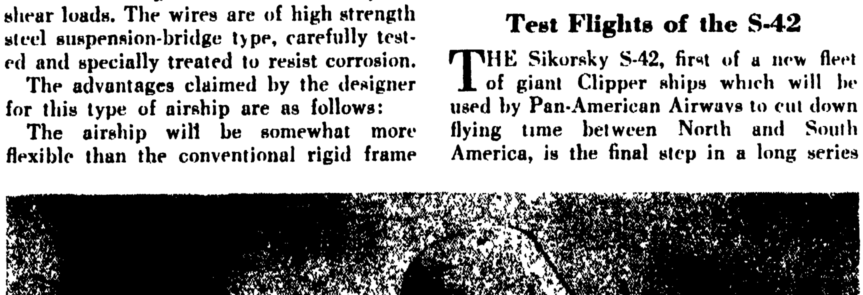
THE Sikorsky S-42, first of a new fleet of giant Clipper ships which will be used by Pan-American Airways to cut down flying time between North and South America, is the final step in a long series of developments by the Sikorsky company. This began with the historic S-36 created in 1928, which was equipped with a 500 horsepower motor, had a gross weight of 8000 pounds, and a top speed of 90 miles. Then followed in logical evolutionary steps the S-38, a twin-engine 8-passenger amphibian, and the S-41, a 1100-horsepower 12-passenger amphibian, with increased carrying capacity and speed.

The S-42 is the largest flying boat ever built in the United States, although its proportions are so well balanced that it does not give the impression of huge size. It has a gross weight of 19 tons, an estimated cruising speed of 150 miles per hour, and a comparatively small wing area of 1330 square feet. The wing span is 114 feet and the overall length is 68 feet 8 inches. As a passenger airliner, the new Clipper will provide accommodations for 32 passengers, a crew of five, a thousand pounds of mail and express, and will have a range in excess of 1200 miles. Four supercharged, geared down "Hornets" give a total of 2600 horsepower.

Our photograph shows the well streamlined design, the motors nestling in the leading edge of the wings, and the carefully balanced controls. The hull is of the two-step type which facilitates the pilot's work in take-off.

One of the most interesting features of the new flying boat lies in the instrumentation and its arrangements. As our seaplanes grow in size, so do the pilots' and mechanics' quarters grow in resemblance to the navigating deck and engine rooms of ocean liners.

The actual flying instruments are in duplicate on either side of the cockpit, a set for each pilot. On these panels are a compass, a directional gyro, an altimeter sensitive to ten feet, and a rate of climb indicator. In a center panel are located four tachometers, and four manifold pressure gages. In the center provision is also made for an automatic pilot which will be installed when the new ship goes into service.



Side view of the new S-42 to be used in the South American service

There is a definite "engine room" between the pilot's compartment and the passenger cabin. Here the mechanic is seated with a multitude of dials and instruments in full view. The electrical system controls and light switches are mounted on the bulkhead beside the radio operator's seat. The mechanic has close to his hand an emergency lever by which the engines, in case of fire, can be smothered with extinguishing gases. The gasoline tanks are mounted in the wing, immediately behind the engines.—*A. K.*

Warm Above—Cold Below

UNITED Air Lines report to us a curious atmospheric oddity. During two years of weather observation their Meteorological Department has found that inversion of temperature is common throughout the winter months. Warm air lanes are then present over cold surface temperatures.

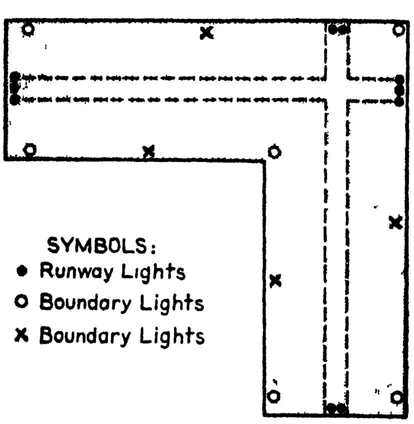
Hitherto it has been believed that the temperature dropped at the rate of 30 degrees, Fahrenheit, with each 1000 feet increase in altitude. Yet pilots have taken off from wintry airports and encountered relatively mild weather at higher elevations. Sometimes they have noted as much as 40 degrees temperature inversion between the ground and altitude.

A systematic study of upper air climatic conditions is now being made. The information will be relayed to pilots via radio telephone, and advantage will be taken of temperature inversions.

This inversion of temperature may be caused by warm air moving in from the south at high elevations, a cool stratum of air near the surface, or it may occur due to the cooling of lower lanes of air by radiation.—*A. K.*

Flasher Lights for Airports

THE Department of Commerce is making a great effort to provide a large number of small airports or landing fields all over the country. Such airports, however small, must be amply lighted. Our sketch



An L-shaped airport and the location of guide lights for landing

shows an L type field, 2000 feet long, 700 feet wide on each leg, with runways 100 feet wide. This L field is well lighted because it has six green lights for one runway, four green lights for the other, six red boundary lights at extremities of the field, and four red boundary lights at intermediate points. Such a lighting system is ample, but it is also apt to be expensive and involve much underground wiring.

Since minimum expense is a vital feature in the extension of the small airport system, a simple self-contained safety flasher light has been developed by the Lakewood Engineering Company and ap-

One of the new battery operated flasher lights for use at airports

proved by the Department of Commerce. This device is illustrated in one of the photographs. The small Neon tubes employed are distinctive in color, and the fact that there are 55 to 60 flashes per minute prevents confusion with any other ground lights which the pilot may encounter. The flashing lights are operated by special motors supplied with current by a 6-volt storage battery. Under average conditions the unit operates without attention or recharging for six months. The fact that neither cables nor conduits are required makes possible the transfer of the units to new positions as desired. There is added safety that electrical storms or break down of the general electric supply need no longer be feared. -*A. K.*

Aviation Crash Rescue Boats

RECENTLY a noted Marine Corps pilot was drowned off Pensacola, although he had jumped from 3000 feet and his parachute had opened up in a normal manner. Wherever naval aviation forces operate intensively such accidents as well as crashes into the water occur from time to time.

The Bureau of Aeronautics has now secured some very fine and well equipped rescue boats. These boats are 45 feet in length and, equipped with two converted Packard aircraft engines of 650 horsepower each, can make 45 miles an hour in waves of two to three feet in height. They are V bottom boats and must stand a three-hour endurance test at 85 percent of their top speed. They will carry a crew of six—coxswain, engineer, doctor, hospital corps man, and an aviation carpenter's mate. Since flier's lives as well as valuable planes are involved, the constant efforts of the Bureau of Aeronautics are fully justified. —*A. K.*

Non-Shatterable Spectacles

FOR use by sportsmen, motorists, and workers in occupations where protection of the eye is of utmost importance, unshatterable spectacle lenses have been placed on the market by a British concern. These lenses were recently seen in the store of Aitchison & Company, New York.

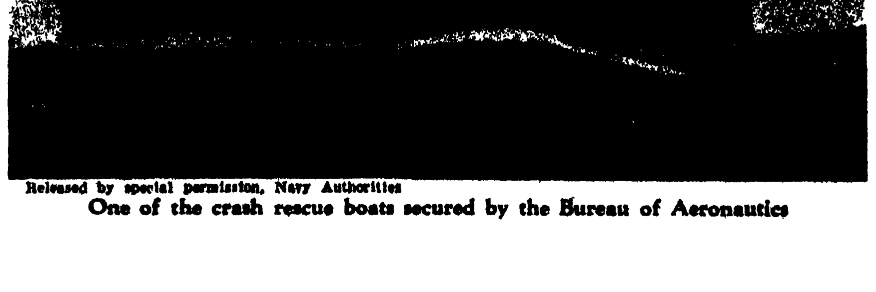
The material used in the lenses is the familiar shatter-proof glass, being made of two layers of glass with a layer of celluloid or some similar composition sandwiched between them. The lenses are blanked and ground in the usual manner.

Volcanoes and Tulips

WEATHER changes that visit blessing or bane on the tulip bed in your front yard and the sprouting radishes in your back garden sometimes receive substantial contributions from the remotest causes. A major volcanic eruption in Java or Alaska may fill the upper air with dust so fine that it will float 'round and 'round the world for two or three years before it settles out, and while it is aloft it helps to produce persistently chilly, often rainy weather and your garden feels the consequences.

This and other effects of great volcanic explosions, such as that of Katmai in 1912 which kept the Iowa corn crop from ripening one or two seasons later, were discussed before a meeting of the American Geophysical Union in Washington by Prof. W. J. Humphreys of the U. S. Weather Bureau.

Volcanic dust in the upper atmosphere, Prof. Humphreys said, heralds its presence by strange effects on the sunlight as well as on the weather that follows disturbances in the radiations that reach and proceed from the earth. At such times the sun becomes surrounded with peculiar rings or haloes, resulting from the scattering of its rays by tiny dust particles. A large pro-

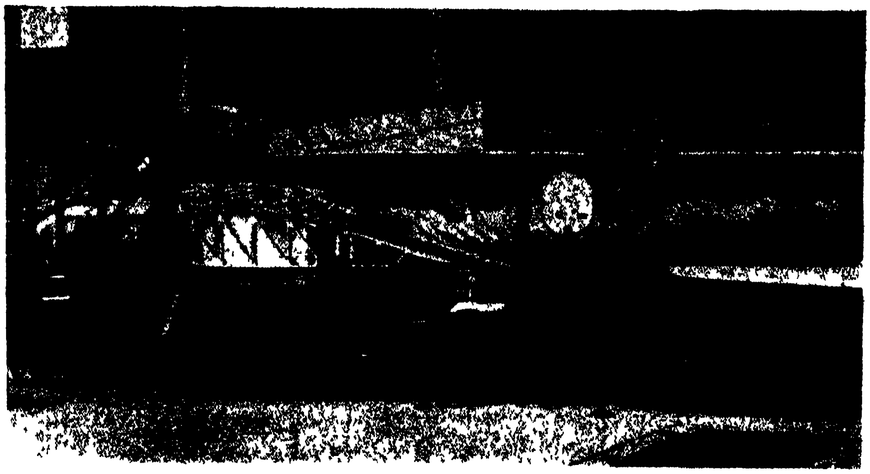


Released by special permission, Navy Authorities

One of the crash rescue boats secured by the Bureau of Aeronautics

portion of these seem to be actual microscopic bubbles with shells of stone, puffed out like the much-advertised "grains shot from guns," and in exactly the same way, by the sudden expansion of internal steam.

We might even get the paradox of a frozen earth produced by too much activity by fire-mountains. To reduce the intensity of direct solar radiation by 20 percent, probably not more than one fifteen-hundredth of a cubic mile of volcanic dust, hurled into the upper air every couple of years and kept going a long enough time, would quite suffice. It would not matter even where the volcanoes were situated, so long as they blew their dust high enough to set it afloat around the world. Thus the northern lands might conceivably become ice-blanketed through an active conspiracy of a ring of tropical volcanoes.—*Science Service.*



Testing an airplane to destruction. Bags filled with lead shot are placed on the wings and fuselage to determine the stresses which the plane will resist

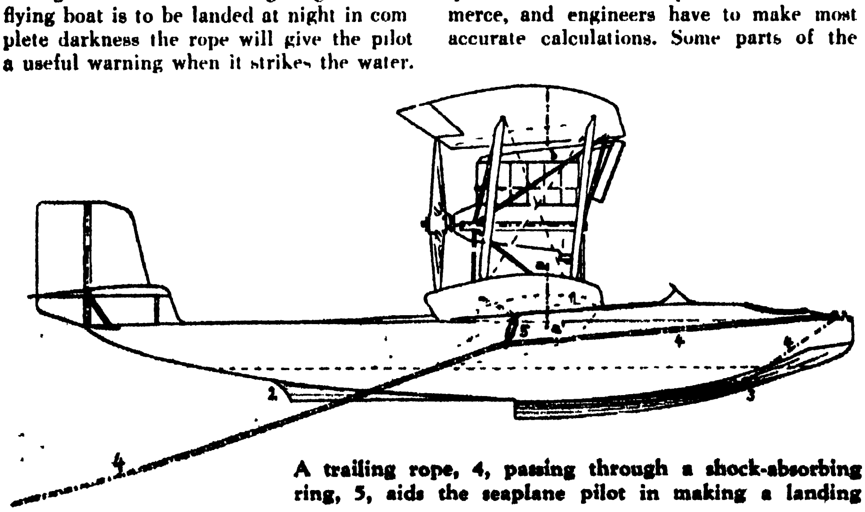
More Explosives in 1933

THE quantity of explosives manufactured in the United States and sold during 1933 for use in mining and quarrying, and for other industrial purposes, amounted to 255,989,391 pounds, according to reports from companies engaged in the manufacture of explosives. This figure represents an increase of 9 percent over the quantity sold in 1932. Sales during 1933 included 64,210,675 pounds of black blasting powder, 33,927,443 pounds of permissible explosives and 157,849,273 pounds of other high explosives. (Permissible explosives are high explosives that have passed certain tests by the United States Bureau of Mines for use in coal mines.)

When compared with 1932, the quantities of explosives sold in 1933 represented an increase of 5 percent for permissible explosives, 14 percent for other high explosives, and less than 1 percent for black blasting powder. Mining and quarrying operations used 99 percent of the total quantity of permissible explosives, 51 percent of the total quantity of other high explosives, and 92 percent of the total quantity of black blasting powder.—*A. E. B.*

An Aid to Seaplane Landings

A GERMAN flying-boat pilot describes in *Flugsport* a useful wrinkle for seaplane work. A stout manilla rope is led through the keel ring 3 (see drawing) and through the shock absorbing ring 5. If the flying boat is to be landed at night in complete darkness the rope will give the pilot a useful warning when it strikes the water. Furthermore, if knots are tied at the end of the rope it will act as a brake and bring the boat to rest quickly—just as do the brakes on airplane wheels. Flying-boat pilots have a technique all their own and there is as much seamanship as airmanship required for successful seaplane operation.—*A. K.*



A trailing rope, 4, passing through a shock-absorbing ring, 5, aids the seaplane pilot in making a landing

Would You Be An Engineer?

THE boy who has his heart set on being an engineer can now find out whether he has a gift for engineering, before spending long years of college preparation.

New scientific tests which measure aptitudes for engineering were described recently before the Midwestern Psychological Association. Prof. Clair V. Mann of the Missouri School of Mines and Metallurgy is author of the tests, on which he has been experimenting for nearly 10 years.

The tests are designed to appraise a freshman's possession of qualities actually used in engineering. Among these Professor Mann mentioned co-ordination of hand and eye, visual perception of spatial relationships, form discrimination, and other aptitudes on which the raw recruit must rate well if he is to win success in this line.—*Science Service.*

Testing Planes to Destruction

IN designing an airplane, the structural strength has to meet certain specific requirements of the Department of Commerce, and engineers have to make most accurate calculations. Some parts of the calculations, however, although thoroughly made, leave uncertainties. To meet such a situation the most expensive plane structures are frequently tested to destruction by piling huge quantities of bags, filled with lead shot, on the plane under test in such fashion as to simulate the air loads imposed in flight. One of our photographs shows the fuselage and stub wing of a Boeing 247 transport plane being submitted to this expensive form of experimentation at the army field in Dayton, Ohio. The bags, it will be noted, are not uniformly distributed. They are concentrated at those points where the maximum loads appear in the air or on landing. This particular ship withstood a loading at least 20 percent in excess of the requirements, an excellent guarantee of structural safety.—*A. K.*

Movies of Boulder Dam

TO make available the newly edited official Government progression motion pictures of the Boulder Canyon Project to a larger percentage of those requesting dates for exhibition, the Bureau of Reclamation, Department of the Interior, has recently issued a permit for a business enterprise which is now known as the Boulder Dam Film Library. Stipulations of the permit require the Library to stock sufficient prints of the complete progression film in both 16 mm. and 35 mm. to meet the demand. The Library, which is located in the Boulder Theater Building, Boulder City, Nevada, for a nominal charge, forwards the prints anywhere in the United States that they are desired for showing.

The edited feature, known as the Boulder Dam Progression Motion Pictures, tells in film the complete story to date of the building of Boulder Dam. The film at present is four thousand feet long. It is estimated that the feature will exceed eight thousand feet in length when work is completed on the project.

Hard Copper Alloys

COPPER alloys three times as hard and twice as strong as ordinary copper alloys have been developed under the trade name of Kunial alloys. These improved metals can be extruded, rolled, drawn, and cold worked exactly in the same way as ordinary brass, for the production of rod, wire, tubes, strip, and sheet.

Kunial brass is an alloy of copper and zinc, together with other added elements. The copper and zinc contents may be varied within wide limits, but in all cases the unique property of hardening and strengthening by suitable heat-treatment is retained. By heating the soft quenched alloy to 500 degrees, Centigrade, the hardness is increased, the tensile strength is increased by 14 tons per square inch, while the elongation is only halved. If the cold-worked alloy is heated to 450 degrees, Centigrade, the hardness is increased, but the increase in strength is accompanied by an increase in elongation.

Kunial brass is an ordinary commercial alloy, and while the raw materials used in its composition are more expensive than those in ordinary brass, for products of equal strength, it may be possible to produce the finished article cheaper by this method than ordinary brass. This entire range of alloys possesses high resistance to corrosion by sea-water, and possible applications are wide.—*A. E. B.*

Radiator Rust Screen

RUST scale is the greatest cause of motor-car radiator overheating. The modern gas engine has long been equipped with an oil screen and an air screen to protect it, and a gasoline screen to protect the

carbureter, and now comes a screen to protect the radiator.

Because the radiator is made of brass and solder, it does not produce rust. The rust that clogs the radiator comes from the cast-iron water jacket of the engine. When enough of this rust gathers in the radiator, it cannot be removed, and in hot weather the water in the radiator boils.

This new device inserted in the upper rubber hose, connecting the radiator and engine of the car, will stop all rust scale from entering the radiator.

The area of screen openings is three times the size of the hose; therefore, the screen does not interfere with the flow of water. The screen is smooth and polished, and the vibration of the engine causes the rust particles to drop to the bottom of the screen. To clean the screen, loosen the thumb screw and withdraw the screen.

The screen is applied in a few minutes by cutting through the hose and clamping in place. It is supplied in different sizes according to hose diameters.

Left-Handed Children *Do Not* Read In Reverse

LEFT-HANDED children are no more likely to see "was" as "saw" than are right-handers when learning to read, a study of the reading habits of 2000 children in early grades indicates, according to the University of Michigan Bureau of Educational Reference and Research. This finding upsets a theory held by psychologists of the Adler school and others, who believe that a "southpaw" naturally tends to look at a word from the wrong end, just as he writes and draws "in reverse."

In naming familiar objects pictured in a square, 93 percent of the right-handed naturally worked from left to right, in customary fashion, but 88 percent of the left-handers did also. Similar tests showed that a left-handed individual has no more trouble

Left: Rust screen for automobile radiator systems. _Above:_ Removing a quantity of rust from one of the screens. Operation described in text

in operating his eyes in the usual fashion than his right-handed brothers.

"In the first steps in reading, when a child is introduced to the alphabet and its arrangement into words, 'saw' might as well be 'was,' or 'are' 'era,' since the arrangement of letters is largely a matter laid down dogmatically in advance by adults, on the basis of adult experience and custom," says Professor Woody.

"A right-handed child is as likely to perceive wrongly these abstract adult symbols as is a left-handed one. The reversal of a word, or letters in a word, is a natural response in the early reading attempts of a normal child, and such behavior is not necessarily a symptom of special disability, the habit usually disappearing with increased experience in reading," he states. "In drawing or writing the left-handed individual normally handles his pen or pencil in reverse because the right hand grip and operation actually prevent his seeing a part of what he is drawing or writing."

Perfume from Waste Grape-Fruit Rinds

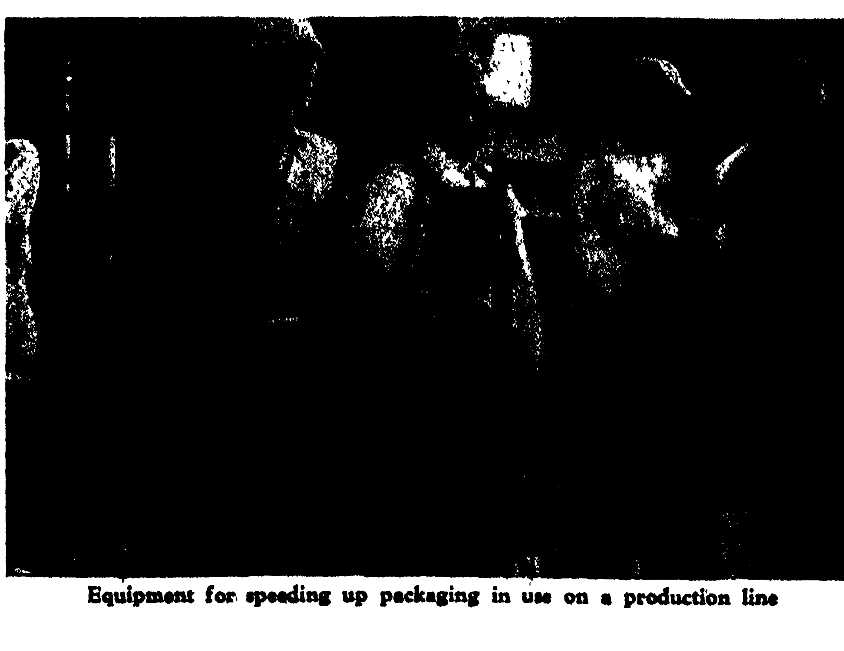
GRAPEFRUIT rinds, discarded by Florida canners, can be used as raw material for valuable essential oils used as flavors and perfumes, declare E. K. Nelson and H. H. Mottern, chemists of the United States Department of Agriculture. About 100,000 tons of grapefruit are processed annually by the canners and at least half of the rinds could be profitably collected. This amount of rinds should produce about 50,000 pounds of essential oils, Mr. Nelson informed the American Chemical Society at a recent meeting in St. Petersburg.

The Government chemists have found that the grapefruit oil contains 90 percent of limonene, or oil of lemon, 2 to 3 percent of volatile constituents and 7 to 8 percent of non-volatile, waxy constituents. Oil of lemon is used in many perfumes and the other ingredients are used for sharp odors and flavors. In the terpene-free oil of the Florida grapefruit, Mr. Nelson reported, the following constituents were identified —octyl and decyl aldehydes, geraniol and octyl alcohols (both free and combined), cadinene, and small quantities of citral and methyl anthranilate. The latter is the flavor of grapes and is manufactured synthetically to flavor some grape juices. -*A. E. B.*

Speeding Up Packaging

NEW equipment for the packaging production line is said to assist greatly in speeding up operations of binding with steel straps. A new tool mount holds the Acme strapping tool always in position, ready for use, and is instantly adjustable to packages of various heights.

A package guide and stop, which contribute to the speed and ease with which the strapping operation is performed, may be obtained to meet particular needs. It is



Equipment for speeding up packaging in use on a production line

said that this new equipment can be easily installed in existing conveyor systems or can be furnished attached to a roller conveyor. For anything from small bundles to huge crates, there is a correct type of improved strapping equipment.

White Light from Carbon Dioxide

"BY bottling carbon dioxide, the air we exhale, in a glass tube and passing an electrical charge through it, the resultant light is almost a perfect white in color," according to Dr. Harvey C. Rentschler, Director of Research of the Westinghouse Lamp Company, in a recent address to the Lighting Institute of the Electrical Association of New York. "The nearly perfect white light obtained by passing an electrical charge through carbon dioxide gas makes this source of illumination particularly desirable for color matching work, as in printing plants, textile mills, or in any industry where the container or package must be matched for constancy of color," Dr. Rentschler said.

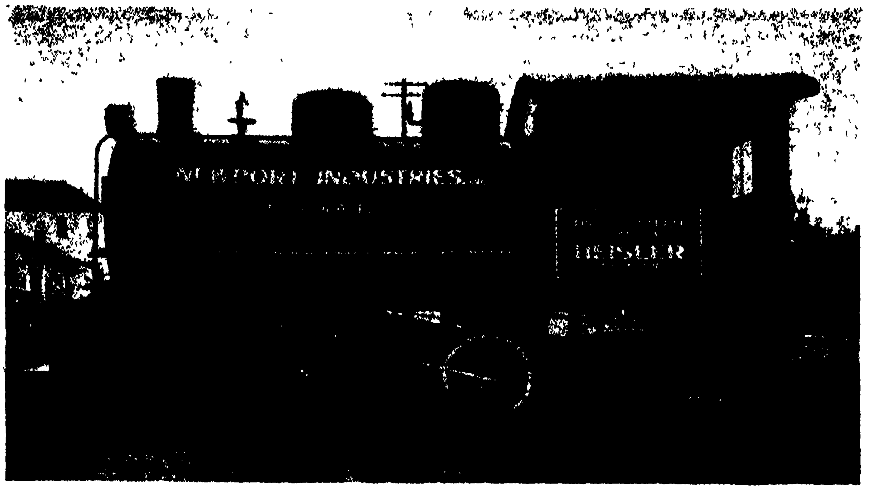
Low operating efficiency was cited as the reason why this lamp was not used more extensively. It converts electricity into light at an efficiency varying from three to five lumens per watt. The cost of operating this lamp at such a low efficiency would run too high to be practical. A standard tungsten filament incandescent lamp is about three times more efficient.—*A. E. B.*

Fireless Locomotive With Arc Welded Tank

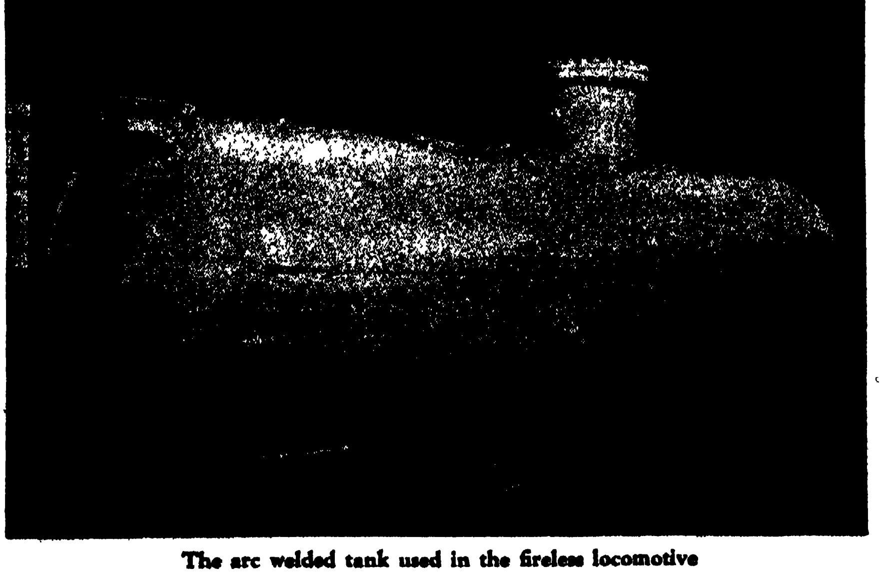
THE first known locomotive to use a fusion welded tank is a new fireless steam locomotive built by the Heisler Locomotive Works. Without boiler or firebox, the steam locomotive hauls a train of freight cars at rapid speed. The secret of the economy and unique advantages of this different type of motive power lies in the steam charged arc welded tank, 69 inches in diameter and built for a working pressure of 215 pounds. It was built by the Struthers-Wells Company, using the shielded arc process.

This tank, which is heavily lagged and jacketed to prevent loss of heat, is filled with water to about four fifths of capacity. Then, by a steam pipe run from a stationary boiler to a point below the level of the water in the tank, the water is heated until the pressure and temperature in the locomotive tank are the same as in the stationary boiler from which the charge is being taken. It is from this heat stored in the water that the locomotive gets its power. For example, the tank on a 60-ton fireless locomotive, charged to 200 pounds pressure, stores sufficient energy to run the locomotive by itself over straight level track, a distance of about 95 miles, or to haul a train of three loaded freight cars weighing 210 tons a distance of 21 miles or more.

Advantages claimed for the fireless locomotive are low initial cost, reduced maintenance, one man operation, longer useful life, and 60 percent to 90 percent greater hauling power. Since there are no smoke or fumes, the locomotive may be operated inside buildings.



The fireless locomotive will run 95 miles on one "charge"



The arc welded tank used in the fireless locomotive

Infra-Red Rays Aid in Diagnosis of Varicose Veins

PHOTOGRAPHS taken through the skin by means of the invisible infra-red rays of the spectrum are now helping physicians to detect varicose veins and obstructed veins. They are expected to prove even more valuable in determining the success of treatment in these conditions.

Pictures taken with photographic plates not sensitive to infra-red rays show the skin approximately as the eye sees it. But when infra-red sensitive plates are used, a very distinct pattern of the veins under the skin appears in the finished picture. On this type of photograph physicians can see varicose veins or obstructed veins, when they are present, and can watch directly the effect of treatment by taking more of these infra-red photographs during the course of treatment.

The results with infra-red sensitive photographic plates are due to the fact that the skin is somewhat transparent to these rays. As they penetrate the skin and the tissues just beneath it, they become scattered and are reflected back to be picked up by the lens of the camera. Where there are blood vessels just below the skin, near the surface, the intensity of the rays reflected back is less than in the parts where there are no blood vessels. The superficial veins, therefore, show up in contrast to the rest of the flesh, looking on the finished picture as if they had been traced with a heavy pencil.

The infra-red sensitive photographic emulsions being used in medical diagnosis have previously been used to take pictures in darkness, at great distances (331 miles), for important astronomical observations, and are used in the "fog navigation camera" aboard the S.S. *Manhattan*.—*Science Service.*

Absorbent Cotton in Home Shop or Laboratory

ABSORBENT cotton is usually thought of by the average person as a useful accessory in medicine or surgery. However, there are many hundreds of other uses to which it can be put, and these have recently been sought out by the Consumer Research Department of Bauer & Black. A few of those which will interest home work-shop and laboratory workers are suggested below:

To absorb fluids accidently spilled, place a tuft of cotton in the puddle. Often damage to surfaces can be prevented and perhaps some of the spilled fluid recovered by squeezing over a suitable receptacle; Filtering all sorts of fluids by placing a film of

cotton over wire gauze in a funnel; Drying out molds by packing with cotton and then removing; Picking up fine fragments of broken glass which defy ordinary cleaning methods, by using moist absorbent cotton; Insulating containers for experimental work; Germinating seeds in a bed of moist cotton; Polishing, drying, and cleaning especially where delicacy is required; Retaining moisture in home-made or ready-made humidors; Retaining oil in oil cups and the like.

Salt-Ice for Extra-Cold Refrigeration

ICE that is "colder than ice" is the latest stunt for certain types of refrigeration —notably for the shipment of perishables by truck or railroad. But the new ice won't do for ice-water for it is made from very salty water, the proportion being 23 percent salt and 77 percent water. This mixture has the lowest melting point of any salt solution—that is why it is used for this extra-cold ice. Salt ice is being made in two forms. small, loose, broken ribbons and compressed blocks weighing about 30 pounds.

According to Arthur D. Little's *Industrial Bulletin*, the frozen brine melts at a temperature lower and more uniform than can be obtained with mixtures of salt and crushed ice, and its heat-absorbing capacity is considerably greater. Convenience in use is another advantage; no mixing is necessary. Small quantities are required.

Refrigerating units have been designed for salt ice, which, it is claimed, make possible the production of a temperature of 0 degrees, Fahrenheit, in ice-cream delivery trucks, even on hot summer days. Uniform temperatures up to 36 degrees Fahrenheit may be maintained by adjustment of conduction surfaces. Besides ice cream, commercial lots of frozen foods, fish, meat, and vegetables have been successfully refrigerated with frozen brine.

In the process of manufacture, a metal cylinder with calcium chloride brine at —30 degrees, Fahrenheit, on the inside rotates slowly in the sodium chloride brine to be frozen. Heat is rapidly extracted through the thin wall of the cylinder. As the ice forms in thin sheets, it is peeled off and dropped into storage bins.—*A. E. B.*

A New Balance of Gland Power

THE campaign to wipe out diphtheria has made the word antitoxin familiar to nearly everyone. Diphtheria antitoxin is the substance produced in the body to neutralize the injurious poison or toxin of the diphtheria bacillus.

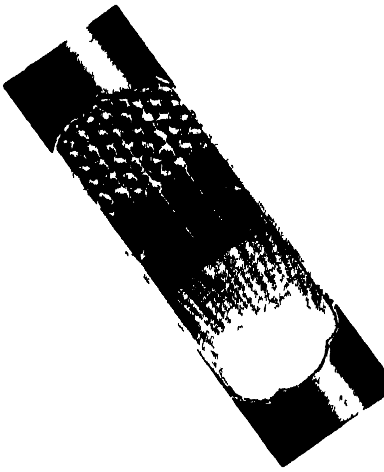
Now scientists have discovered that the body produces similar substances called antihormones. An antihormone checks or neutralizes the effect of its hormone just as antitoxin neutralizes the effect of toxin. The big difference between them is that the toxin is produced by a bacillus or germ, and the hormone is produced by a gland of internal secretion, such as the thyroid or pituitary glands.

Between the hormones and the antihormones there seems to be a newly-discovered balance of power. When this balance is upset by disease or injury of the glands, various distressing symptoms and conditions appear. It is apparently the fine adjustment of this balance that determines whether you will be a giant or a dwarf or a normal-sized individual; whether you will suffer from hyperthyroidism, familiarly known as Graves' disease, or will be fat and sluggish in both mind and body, as a result of suffering from the opposite condition of hypothyroidism.

Overproduction or underproduction of hormones by overactive or underactive glands has until now been considered the cause of these various conditions. The discovery of antihormones offers a new explanation. Not alone that, but it suggests that present methods of treating these conditions will have to be revised. Dr. J. B. Collip of McGill University suggested that the solution of this latter problem may depend on the ultimate ability of chemists to separate the hormones from the antihormones. —*Science Service.*

Expanding Shot-Gun Shell Wad

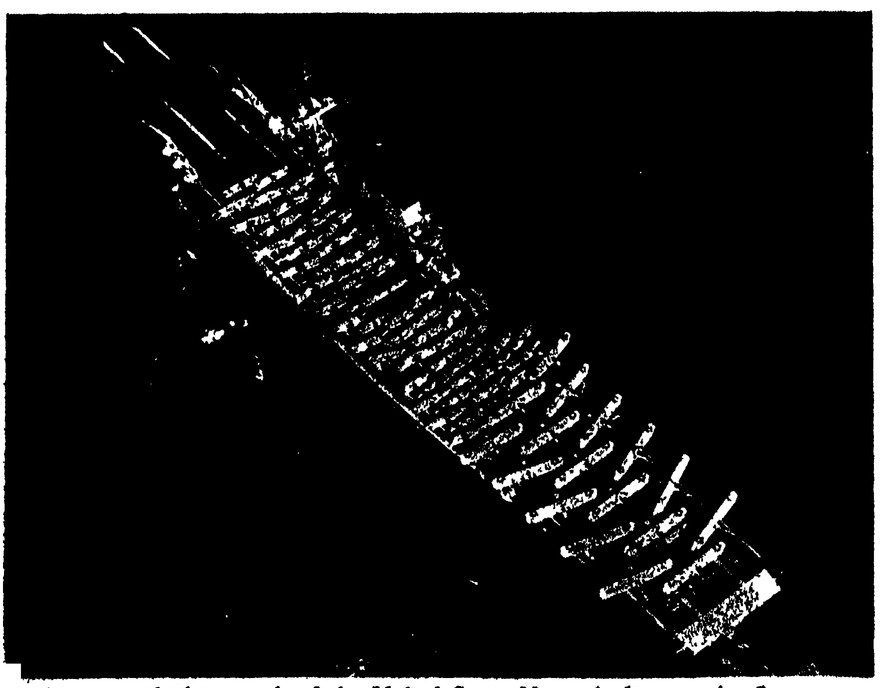
A NEW type of wad to be placed between the powder and shot in a shotgun shell and which has several advantages over older styles has recently been developed by the Western Cartridge Company. This wad, called the Seal-Tite, is of such



The new shot-gun shell wad, behind the shot, showing how it expands

form that the pressure of the powder gases on one side and the resistance of the shot on the other expand the wad tightly against the wall of the barrel and thus definitely prevent the escape of gas into the shot column and its consequent effect on the pattern.

The material used in making this new wad is non-hygroscopic and therefore will neither take moisture from the powder nor give it moisture. It also can have no chemical effect upon the powder.



An unusual photograph of the United States Navy airplane carrier *Saratoga*, with a group of planes on the flying deck. A large part of these planes, grouped amidships and toward bow of the ship, are Boeing single-seater fighting planes

New Ink to Permit Reclamation of Paper

WHAT becomes of all the out of date telephone books? You may have noticed how insistent the telephone company's representative is about getting the old book, when he calls to leave a new one. His anxiety to carry away the out-of-date directory is due primarily to the telephone company's desire to save operators the time-loss resulting from the accidental use of old directories. Staggering quantities of these books are accumulated each time a new directory is published and the question of what becomes of them leads up to a very interesting story of modern chemistry.

For many years, paper makers have tried to develop some satisfactory process for removing printers' ink from old papers. Reasonably successful processes have been developed from time to time but in general, the problem of removing the finely divided carbon black, which constitutes the basis of most printers' ink, involves such expensive washing treatments that it hardly pays to reclaim the paper fibers.

Then somebody got the bright idea that it might be possible to use another kind of ink which could be bleached by a simple

(*Please turn to page* 47)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

AMATEUR telescope makers and astronomers within a radius of one light-year of *Stellafane*, near Springfield, Vermont, are invited to attend the Ninth Annual Convention of their fellow enthusiasts, which will be held there on Saturday, July 21. Mr. A. D. Baker, secretary of the "Telescope Makers of Springfield," the hosts, states that among other attractions this year there will be a spectroheliosoope which the members of that organization are putting on all steam to finish in time. Come.

In the number for last February we opened up the subject of automatic guiding of telescopes, pointing out the great need for it among astronomers, and in the May number we hinted at it again. It now appears that several have had this idea on their mind for some time, and one of these is Wilbur Silvertooth of 273 Ximeno Avenue, Long Beach, California. He writes:

"My interest in astronomy has led me to make several telescopes, among which were a six-inch reflector, made when I was 14, and an 11-inch Cassegrainian, completed last fall. [See cut, opposite page.—*Ed.*]

"Your column in the February issue now prompts me to send a sketch of a device I experimented with some time ago. Referring to this sketch, the photographic plate was fastened to a circular aluminum plate, which was in turn suspended by three heavy springs. The 'electric eye' was the same diameter as the eyepiece, and replaced it when a suitable guide star was located. The photo-cell used contained copper nitrate, sealed in. The surface of the triangular glass prism was coated with cupric oxide. This, with the carbon, was sensitive to light. However, except on bright objects (2nd mag.) the action was poor even with '210 amplifiers. Since then I have tried selenium, which seems more sensitive.

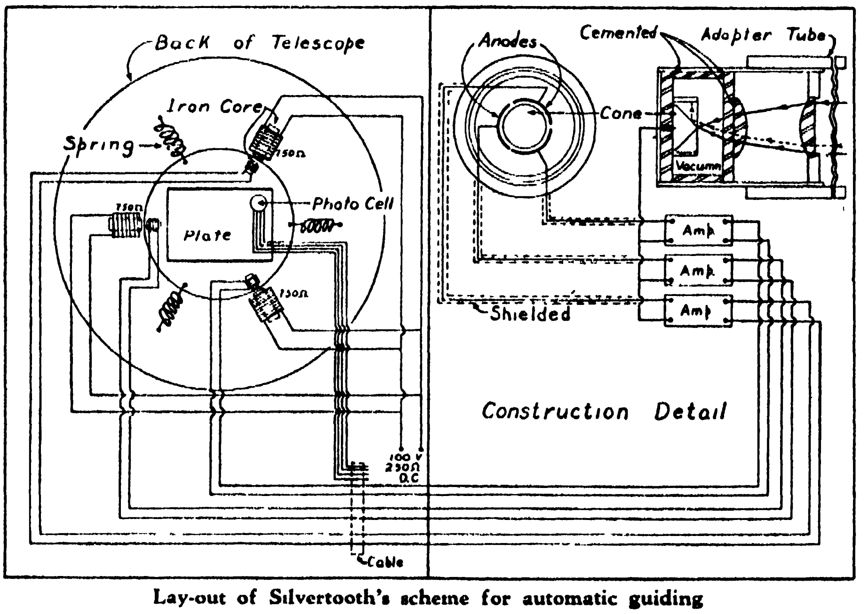
"The advantages of this device are obvious, in that it requires no partitions between the elements, no mechanical relays to make the motion jerky, and has freedom of motion on an infinite number of diameters. The correction is made almost before the shift occurs."

WE invited Mr. Silvertooth to expand the above note, and the following is what he then wrote:

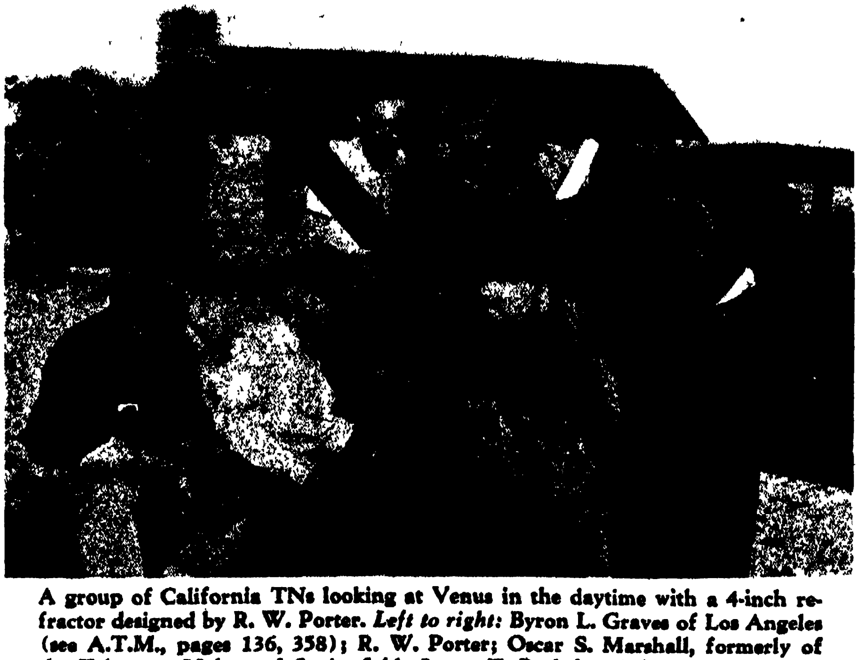
"The cupric oxide in conjunction with the copper nitrate is photo-sensitive, the carbon having no effect other than as the second terminal, or anode, to complete the circuit. Any other electrical conductor would serve equally as well. Since some photo-cells require a series resistance, the carbon acted in this capacity.

"The plate (see drawing) is fastened to a circular aluminum (or other non-magnetic material) disk, which is in turn suspended by three heavy springs, leaving it free to swing on any lateral diameter. The photo-cell is located in one corner of the plate, according to conventional practice. An ordinary eyepiece is first used to locate a suitable guide star, later being replaced by the photo-cell. All connections from the cell and magnets are contained in one flexible cable. The magnets which move the plate are similar in principle to the dynamic speaker in a radio, viz: the large outer magnets are rigidly attached to the telescope proper. They create a strong magnetic field. The smaller magnets on the movable plate vary in strength and thus cause the plate to shift. In this manner there are no moving parts other than the plate itself. This eliminates friction and reduces failure in operation to a minimum. The anode leads from the three segments must be shielded to avoid mutual conductance.

"In reference to the drawing, the solid rays represent the position of no movement. However, if the star image should shift (see dotted line), the resistance of the cell would be reduced in that direction, causing a current to pass from the central cone to one or two of the segments, depending upon the direction of the shift. It is evident that the greater the shift, the shorter the distance will be between the cathode and anode, causing a greater decrease in resistance and a consequent increase in the amount of current passing through the par-



Lay-out of Silvertooth's scheme for automatic guiding



A group of California TNs looking at Venus in the daytime with a 4-inch refractor designed by R. W. Porter. *Left to right:* Byron L. Graves of Los Angeles (see A.T.M., pages 136, 358); R. W. Porter; Oscar S. Marshall, formerly of the Telescope Makers of Springfield; James T. Barkelew (whose paper on automatic guiding will appear next month); Hart, expert mechanic at "Cal Tech" shops; Dr. John Strong, who invented and developed aluminizing by evaporation

ticular magnet, with a proportionate effect.

"The cone, or cathode, is first silver plated and a lead is then fused on. The anodes are set up around the cone, as pictured. A small capsule containing calcium and caesium oxide is placed on one side, and the device is evacuated and sealed. It is then placed in a high frequency furnace which heats the capsule and the anodes.

Silvertooth and his Cassegrainian

The caesium formed condenses on the cool cone and glass container. After that, with the aid of a small gas flame, in conjunction with the furnace, the caesium is persuaded to condense entirely upon the cone. I believe the introduction of three anodes in one cell is novel.

"The resistance type amplifier was used to minimize distortion, even though more stages were required. No attempt was made to employ alternating current, as this would be fatal to successful operation.

"A few minutes study will show that a single star is not necessary as a guide. A planet, a cluster, or any other such object would serve equally as well, as it is the *relative* intensity of light in each of the three segments that is the determining factor, and not the sudden presence or absence of light. As long as some object is present in the field the plate will immediately adjust itself so as to divide the light equally in three parts, and will then maintain this position throughout the exposure."

NEXT month we hope to publish a longer contribution on the same subject, sent in by James T. Barkelew of Los Angeles.

Several astronomers with whom we recently discussed automatic guiding shook their heads. One stated that he would like to see the idea tried out, while another seemed to think that nothing could replace the human factor in following a star image around when it was moving rapidly and irregularly. A third emphasized the extremely high criterion for his own work on parallax plates: while most of the experimenters have aimed at one 10,000th of an inch as their criterion for precision, this astronomer demanded one 50,000th of an inch.

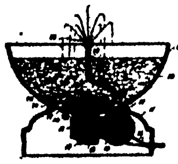
This matter of automatic guiding provides an excellent opportunity for the inventive amateur telescope maker to donate something really worth while to astronomy —since it is fairly evident now that he will not contribute real astronomical work, preferring to center his interest on the mechanical aspect of the hobby. A solution of this practical problem would constitute a major contribution to science.

RECENTLY PATENTED INVENTIONS

Conducted by A. P. PECK

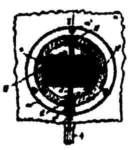
Fountain

Patent Number 1954704. Joseph H. Kraus. A fountain that may be used for either artistic or utilitarian purposes or both is the subject of this invention. As shown in the drawing, a water-tight bowl is provided, the lower part of which is pressed in the form of a sump or well. Within this well and supported on a bearing, is an electric motor rotor of the conventional squirrel cage type. The shaft of this rotor is fixed to a vane which functions as the rotating member of a water pump and which forces water out of the tube shown, from which it emerges in the form of a fountain. The water then falls back into the bowl to be used over again. The field coils of the electric motor are mounted outside of the well and operate the rotor magnetically through the wall of the well. This fountain may be used for purely decorative purposes or for somewhat humidifying the air in a room.



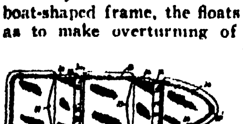
Inclinometer

Patent Number 1954998. August Hoffmann. The primary object of this invention is to provide an instrument for measuring and indicating the tilt or angle of inclination of aircraft. The instrument embodies a gyroscopic rotor mounted on a globular or ball member so that the rotor is capable of turning with the greatest ease. The rotor is surrounded by a partly transparent casing and is furnished with means for visibly indicating the position of the rotor relative to the casing. Thus when the casing is mounted in a fixed position on the aircraft, and accordingly participates in all movement thereof, the rotor maintains a horizontal position and indicates through the opening in the casing the angle of inclination of the aircraft.



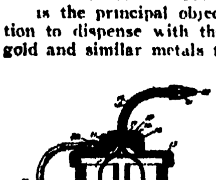
Collapsible Boat

Patent Number 1953059. Alfred Berendt. Several buoyant floats secured at intervals around a boat-shaped frame, the floats being so constructed as to make overturning of the boat practically impossible, is one of the main points of the invention illustrated in the drawing. The frame of the boat is so arranged that sections can be dismantled and stacked together in a compact package. By means of cleverly designed interlocking joints, the boat shaped frame will hold in proper form when assembled yet can be quickly and easily taken apart.



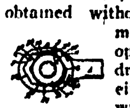
Coating With Metal

Patent Number 1953330. Felix O. Andres. It is the principal object of the present invention to dispense with the necessity of applying gold and similar metals to glass surfaces in leaf form and to provide a new process for applying such metals in a liquid form. This is accomplished by using solutions which when applied to a glass surface will produce an even unbroken film of metal of uniform color and texture. The object is attained by the use of two solutions which are simultaneously sprayed out of a nozzle under air pressure. One solution is a mixture of metallic salts with potassium or sodium carbonate. The second or reducing solution causes a reaction in the metalling solution so that when the two solutions mix, a metallized surface results. By use of certain ingredients in the reducing solution, it is possible to produce in the final results shades from deep gold to green yellow.



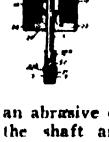
Wrench

Patent Number 1954141. Edward Z. Miquelon. In the novel wrench which is the subject of this invention, the effect of a ratchet wrench is obtained without the usual complication. By means of the specially designed opening shown in the accompanying drawing, which may be applied to either the so-called end or box wrenches, it is possible to obtain a ratchet effect. A small lug grips one corner of a nut or bolt head but the grip may be loosened merely by turning the wrench in the opposite direction.



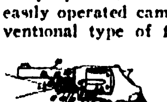
Grinding Device

Patent Number 1954575. George Pearson. Satisfactory operation of gasoline engines depends to a great extent upon the breaker points of the ignition distributor meeting with full face-to-face contact. Pitting of these points makes it necessary that the surfaces be ground frequently if best results are to be obtained. The present invention relates to a grinding device which will do this particular job quickly, easily, and efficiently. Grinding is accomplished by a vertical reciprocating action obtained by means of a solenoid actuating a shaft on the end of which is carried an abrasive element. A flexible coupling between the shaft and the abrasive element makes it possible to obtain accurately ground faces on the ignition points even though the grinding mechanism may not be held perfectly vertical to the points being ground.



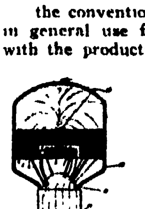
Camera Gun

Patent Number 1955300. Abraham Kurnick. The purpose of this invention is to provide a small easily operated camera in connection with a conventional type of fire arm. The object thus attained is to obtain a photographic record of the target, which record is made at the instant the gun is fired. The small camera with its operating mechanism is mounted under the barrel of the gun, as shown, and levers connect the shutter release with the trigger of the gun. Suitable means are provided for reloading the camera with film and advancing the film after each exposure. It is contended that an invention of this type will be of value particularly to police officers.



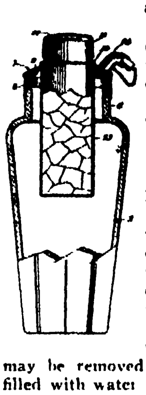
Lamp

Patent Number 1954231. Julius Weinberger. In the conventional types of glow of lamps now in general use for television and in connection with the production of sound records on motion picture film, a potential is applied between two electrodes in an atmosphere of gas and the well known discharge phenomenon takes place. The primary object of the present invention, illustrated in the drawing, is to provide a glow lamp in which it is necessary to use only a small amount of energy for efficient control. This is accomplished by utilizing two elements other than the usual electrodes, one of which is for the purpose of emitting electrons and the other for controlling the electronic flow. Thus by impressing a control potential on the grid, the flow of electrons and hence the intensity of illumination may be accurately controlled with a comparatively small amount of power.



Beverage Shaker

Patent Number 1954369. Morris B. Solomon. Of particular interest in these post-prohibition days is the novel form of cocktail shaker which is the subject of this invention. The ice used as a cooling medium is placed in a separate chamber in the lid of the shaker so that the cooling medium inside never comes in direct contact with the ingredients being mixed. Thus no dilution can take place. The primary purpose of this invention is to provide a detachable cover unit for the container, the cover unit having the ice chamber depending therefrom and being provided with a spout for pouring out the mixed beverage. A cover unit of this type may be interchangeably used in connection with containers of various shapes and sizes. The ice container is so constructed that it may be removed from the cover unit, partially filled with water and placed in the freezing compartment of an automatic refrigerator so that the water becomes frozen.

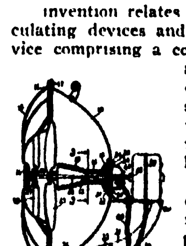


Bolt

Patent Number 1955353. William R. Wiley. One of the difficult problems of fabricating complicated machinery, automobiles, and so on is the placement of bolts so that later these bolts may be used even though it is impossible to get at the heads. The present invention relates to a type of bolt which overcomes this difficulty in a novel manner. In place of the conventional bolt head, the body is bent at an angle as shown in the drawing and the curved part is slotted with a groove. Bolts of this type are used for fastening parts to sheet metal wherein has been punched or stamped a hole of special shape. At one side of the hole is a small tongue which engages with the head of the bolt and thereby holds it in position and prevents it from turning while the nut is being tightened.

Air Circulator

Patent Number 1954872. Alfred C. Gilbert. This invention relates to improvements in air circulating devices and more particularly to a device comprising a combination of an air heater and an air disturbing medium. The heating unit as shown in the drawing herewith is of the general type found in ordinary electrical heaters. This is mounted within a reflector of the conventional type and immediately in front of it is placed the rotating member of an electric fan. In back of the reflector is an electric motor, the shaft of which projects through the heating unit to the hub of the fan. Connections through switches to the source of electric current make it possible to use either the heater or the fan alone or both of them in combination. With a device of this nature, it is possible to obtain the effect of cooling in warm weather by disturbing the air with the fan alone or to have a heating effect by the use of the heating unit either by itself or in combination with the fan which serves to circulate the warmed air to all parts of a room.



The above information has been taken from copies of patent specifications. No further details are available except as can be obtained from such specifications.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 42*)

chemical treatment. Before starting on the development of such an ink, however, it was necessary to investigate the possibilities for using such ink in some field of publication that uses sufficient tonnage of paper to furnish an adequate supply of printed paper and which printed paper could be readily collected and assembled at a central point. The most ideal publication for the purpose proved to be telephone directories. Arrangements were therefore made with the telephone companies to print their directories with a special ink developed by the Hilton Davis Company of Cincinnati, which contained no carbon black and which could be bleached with hypochlorite solution and "discharged" with reducing agents such as sulfur dioxide.

The process used for de-inking the pages of used telephone directories is described by Sidney D. Wells in *Chemical and Metallurgical Engineering*. The antiquated books are first fed into a machine which rips off the covers, tears apart the pages and separates the white paper from the colored. The paper is then ground up to fibers in rod mills, which it leaves in the form of a pulp suspension. This pulp is then treated with sulfur dioxide gas which discharges the ink, leaving a clean white pulp which can be fed directly to the paper machines to produce new paper of perfectly satisfactory quality.

This process is adapted primarily for the reclamation of wood-pulp papers whose permanency is not important.—*A. E. B.*

The Farmer Is Right

EVER since the beginning of time the farmer has believed in the value of sunlight. He has seen his livestock grow strong and healthy in the warm sunlight of spring and summer. He has watched the bursting of buds and the popping of seeds as the sun grew higher in the sky.

The farmer knows that during the winter months he has to be ever watchful of health regardless of the fact that his livestock is housed in warm comfortable buildings. He has observed that a sick animal turned out into the open will seek a sunny protected shelter and oftentimes get well. He has noticed that a plant grown indoors without adequate sunlight hasn't the color, growth, or strength of a plant grown outdoors.

To show the value of sunlight to animal life and growth, the Ohio Experiment Station recently carried on a series of experiments with chickens. Three brooder houses were built. These houses were so constructed that the growing chicks received sunlight in one of three ways. First, direct through open windows; second, through ordinary glass which does not allow the important ultra-violet rays to pass; and third, through a glass-like material known as Cel-O-Glass. One hundred baby chicks were put in each lot. The chicks were fed and managed alike.

Doctors Bethke and Kennard who carried on the experiment made the following

statement at the end of their work: "The chicks were all subjected to the same routine management. The chicks in all groups grew at a normal rate to the fifth week when approximately one third of those in the window glass group showed signs of failure, attendant with a slower gain in weight. By the eighth week all the chicks in the glass group, which was then discontinued, exhibited severe signs of leg weakness. The other two groups continued to make normal growth to the close of the experiment or the tenth week, with no evidence of nutritional failure. No outstanding or apparent difference was noted between the group that had access to direct sunlight and the one which received sunlight filtered through 'Cel-O-Glass.'"

This test and many others of similar nature carried on by various biological chemists at different experiment stations has shown the value of ultra-violet rays on poultry health, growth, egg production and hatchability.

These tests have resulted in a general adaption on the part of poultry raisers, in place of ordinary glass in poultry houses, Cel-O-Glass or similar materials which will let in these valuable rays of sunlight.

Where before the farmer instinctively knew that there was something about sunlight which he felt benefited his livestock, he now knows what it is and why.—*W. H. Allen.*

New Camera Resists Tropical Climate

CHOSEN for its lightness in weight, tensile strength, and durability under all climatic conditions, Textolite, manufactured by General Electric, is used for the body of the Univex camera. This miniature camera consists of but three molded parts. The lens is held in a recess inside the body by a special spring washer clamped by a nut on the end of a screw holding the shutter assembly. The molded part for the loading end snaps into place. Tolerances on the molded parts are so well controlled that no machining is required and the perfect fit allows no leakage of light.

Several hundred of these tiny picture-takers were taken by Captain R. Stuart Murray, famous explorer, on his trip into the wilds of Honduras, to be distributed among the head men and devil doctors of the various Indian tribes.

The metal parts of this camera are rust-proof, and it can easily be carried in a coat pocket. Taking roll-film pictures 1⅛ inches by 1½ inches in size, the camera sells for 39 cents.

Lobster Claw Muzzle

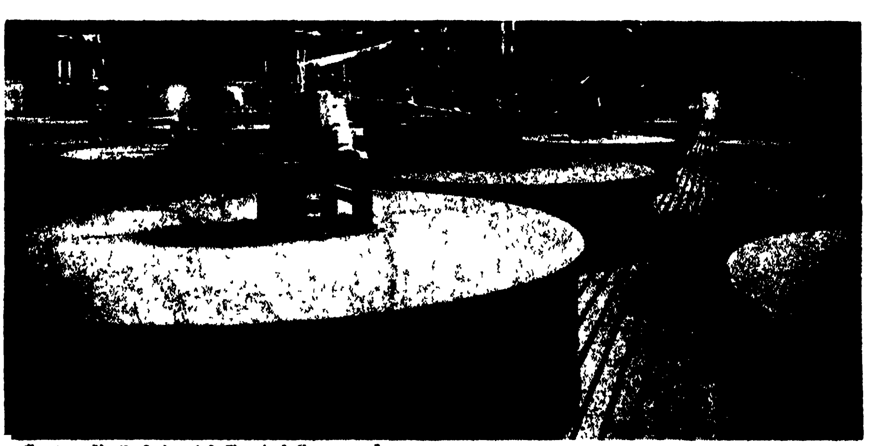
A NEW sea food application for aluminum is a lobster claw muzzle. At present live lobsters are shipped with their jaws pegged by a wood wedge which is driven into the claw. This device prevents the jaws from opening, thus making things pleasant for everybody but the lobster. But the wood wedge injures the meat and likewise causes a certain monetary loss ensuing from lobsters which expire in shipment.

A Boston man has invented a new and humane halter-type muzzle made of coiled sheet aluminum, with a tie of aluminum wire which, when slipped over the lobsters' jaws, prevents biting, damaged tissues, and untimely demise.

Forecasting By Weather Cycles

FACTS brought out in a series of comprehensive comparisons of weather records recently compiled in the Weather Bureau show that no weather cycle, aside from the annual cycle, is of any particular value in forecasting the weather in this country, J. B. Kincer, in charge of the Division of Climate and Crop Weather of the Weather Bureau, United States Department of Agriculture, said at the last meeting of the American Meteorological Society.

Many so-called weather cycles, ranging from a very short period to 260 years, and related to sun spots, tree rings, earthquakes, wheat prices, Nile floods, lake levels, and the position of the planets, Mr. Kincer said, have been proposed as the key to Nature's secret of what the weather will be next winter, next summer, or even on any given day 10 or 20 years from now. If the weather cycle theory were correct, he continued, forecasters today would need only to turn back to the records of any particular season, month, or day.

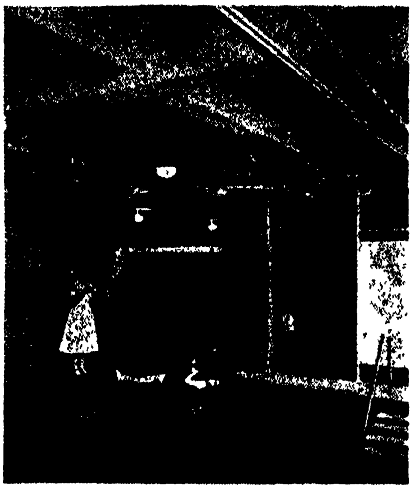


Courtesy U. S. Industrial Chemical Company, Inc.

The largest vinegar plant in the world—but not a drop of the vinegar reaches the public. All of it is used in the manufacture of industrial chemicals. In the photograph, the tubs on top of the huge vats contain alcohol which is distributed over beechwood shavings impregnated with bacterial catalysts. Air entering the bottom of the vats completes the process of converting the alcohol into dilute acetic acid (vinegar) which is practically chemically pure and ready for use

Hospital Monorail Patient Carrier

AN ingenious monorail carrier system, constructed of light aluminum alloys, is used to transport patients in the Infantile Paralysis Department at the University of California Hospital in San Francisco. It consists of a 130-foot rail runway, from which is suspended a movable platform or stretcher. This may be raised or lowered by means of mechanism operated by the nurse.



The monorail carrier in a hospital transporting a patient to the pool

Patients are carried on the platform from dressing room to pool. At the pool they are lowered into the water and in some cases are transferred to special swimming apparatus. After the bath, the patient resumes his place on the platform and is lifted out of the pool and carried back to the dressing room. The apparatus is very light in weight and a nurse propels it with ease.

Care in Cooking Prevents Loss of Vitamins

LOSS of vitamins during cooking takes place in several ways. They may be destroyed by heat and oxidation, or they may dissolve out in the cooking water which is later discarded. The exact extent of these losses depends upon the length of time of cooking, upon the presence of air, and upon the solubilities of the vitamins concerned, says the Bureau of Home Economics, United States Department of Agriculture.

Vitamins B, C, and G are readily soluble in water. Vitamin C is easily destroyed by heat and oxidation. Vitamin B is destroyed by long-continued heating but undergoes little destruction when heated at the boiling point of water for as long as one hour. Both vitamin B and vitamin C are more rapidly destroyed in an alkaline medium than in an acid medium.

Vitamin A is only slightly soluble in water and is not readily affected at the ordinary temperatures of boiling and baking. It is destroyed, however, at higher temperatures such as those that obtain in frying. It is also destroyed when heated in the presence of oxygen. Vitamins D, G, and E are fairly stable to heat and are not destroyed at ordinary cooking temperatures.

The value of any cooked food as a source of vitamins depends largely, of course, on its original value in the natural state.

Tomatoes are an excellent source of vitamin C even after they have been cooked. This is explained by the fact that during cooking the acidity of the tomato preserves to a great extent its naturally high vitamin C potency.

In general, the destruction of vitamins is less when foods are heated at high temperatures for short periods, than when they are heated at low temperatures for long periods. There is also less loss when a small quantity of water or no water at all is used. For this reason it is recommended that foods be cooked as short a time and in as little water as is practical. If any cooking water is left it should be used for gravies or soups unless it is so strongly flavored that this is out of the question. Steaming is one of the preferred methods for cooking since the time required is short and little water is used.

Graphite Lubricator

AN unusually handy device for use around the home, the car, in the shop, or in any one of a hundred other locations, uses dry graphite for lubricating almost anything that needs such treatment. Both the container and the graphite which it uses are essentially new. The graphite

The rubber-sided graphite "gun"

itself is processed to a point where it is of extreme fineness. Thus its lubricating qualities are enhanced.

The container has a wooden base and soft rubber sides. The cap holds a spout which is so arranged with a valve that the flow of graphite can be accurately controlled. Pressure on the sides of the rubber container forces a fine stream of the graphite out of the spout, which can be directed to the point where the graphite will do the most good. Both the container and the lubricant are a product of the Joseph Dixon Crucible Company.

Dry Ice Aids Fruit Industry

A SIMPLE carbon dioxide treatment of fruit shipped in refrigerator cars may become common practice in many fruit shipping districts of the country, according to the United States Department of Agriculture. This would decrease substantially the present annual losses of many millions of dollars caused by rots and other diseases developing in fruit during shipment.

Transit disease specialists of the Bureau of Plant Industry have found that in experimental shipments the greatest development of transit diseases occurs within the first 24 hours after the fruit is loaded in cars, that pre-cooling the fruit stops most of this early disease development, and have discovered that treating the fruit in the cars with carbon dioxide gas has practically

the same effect on disease organisms as pre-cooling.

The principal advantage of the gas method is not that it will replace present pre-cooling practices, but that it will give the advantages of pre-cooling to shippers to whom refrigerating equipment is not available.

The carbon dioxide treatment is simple and has several outstanding advantages. The fruit is treated by placing small quantities of solid carbon dioxide over the load or in the ice bunkers in addition to the ordinary icing. Instead of melting to a liquid as ice does, the solid carbon dioxide changes to a gas and not only cools the fruit but has also a definite physiological effect in preventing the development of transit diseases and in keeping the fruit fresh and firm.

New Paper Milk Bottle

AN entirely new kind of milk container, made of heavy paraffined paper and with a winged self-closing top, has been announced by the Reed Company, Inc. of New York.

In addition to its attractive appearance, which has been approved by both dairies and housewives, this new container offers milk consumers a bottle that is easy to open and close. To open this container, you simply raise the metal top, press back two of the wings, and compress them to form the spout. The container is closed by simply pressing back the spout and replacing the metal clip, which keeps the container tightly closed. This new kind of spout never leaks or drips, and it pours as easily as the spout of a cream pitcher.

Exhaustive tests have shown that the container has sufficient strength to withstand the roughest handling and that, even in extremes of heat and cold it remains perfectly leak-proof and sanitary. As it is made of paper, it eliminates the need of picking up empties, bringing them back, inspecting and washing them. Moreover it does away with bulk, weight, breakage, and waste, and effects a tremendous reduction in bottling costs.

A complete, compact machine, which measures only 4 by 22 feet and can be installed in any dairy, does the entire manufacturing and filling job. Blank sheets of heavy paper of the exact size required are fed into the machine, which makes, sterilizes, fills, and caps the containers in a single automatic operation.

This machine does the whole production job at a rate of speed equivalent to customary production, and at a tremendous saving in material, labor, storage, selling, and hauling. One machinist for supervision and one attendant to replenish supplies on the machine are all that are needed.

Ice Cave Air-Conditions Iowa Editor's House

A CASE of natural air conditioning, whereby a house is air conditioned by a flow of cool air from a cave underground, is related by J. W. Speer, manager of air conditioning products of the Westinghouse Electric and Manufacturing Company.

The house is the property of an editor of a Decorah, Iowa, newspaper. The novel

ventilation system cools his home in summer and helps to warm it in winter.

"When the foundation of his home was being excavated," said Mr. Speer, "workmen struck a small crevice in the rock. Cool air gushed from this crevice which is about two and half feet wide and extends into the rock 20 feet and then makes a turn. Beyond this turn the crevice has not been explored.

"A large size tin pipe was forced into the crevice in order to convey the cool air into the house. Part of the air is conducted to the kitchen where it maintains an even temperature throughout the summer and keeps food in excellent condition. The rest is piped to a room used as an office by the editor. An electric fan located in the pipe line helps draw the cool air into the house. Other fans circulate the air throughout the house."

Air from the crevice maintains an even temperature of 42 degrees the year 'round. As a result, the house is cooled during the hot summer months and is warmed when winter's icy blasts prevail.

CURRENT BULLETIN BRIEFS

Sixth Report of the United States Geographic Board, 1890-1932. The United States Geographic Board decisions are accepted as standard authority by Presidential order. They are rendered by authorities only after extensive study of maps, gazetteers, local histories, and atlases. This is a new Federal Government publication that tells an interesting story of geography in the United States, its outlying parts, and in other countries of the world. 834 pages. *Superintendent of Documents, Washington, D. C.—80 cents (money order).*

National Parks of Canada. Report of the Commissioner for the year ending March 31, 1933. This beautifully printed pamphlet is fully illustrated. *National Parks Branch, J. B. Harkin, Commissioner, Ottawa, Canada.—Gratis.*

Piping a Water Supply Through Salt Marsh and River. (*The Power Specialist*, Vol. II, No. 2, February, 1934.) This pamphlet describes how Scituate, Massachusetts, insured adequate fire protection by laying a pipe line of Transite pressure pipe across a river. Conveyors built up the pipe walls by depositing an asbestos fiber and Portland cement mixture on a rotating mandrel. *Write to Scientific American for Bulletin 6B.—Gratis.*

Values of Foreign Monies, 1934. One page. *Treasury Department, Washington, D. C.—Gratis.*

Hydraulic Power Transmission. The Adaptability of Petroleum Oils. (*Lubrication*, Vol. XX, No. 4, April, 1934.) The idea of applying the principles of hydraulics to power transmission dates back to the 17th Century. It was not until the latter part of the 18th Century that the actual application of the principles evolved

by Pascal was made to industrial machinery in the form of the hydraulic press. The 19th Century saw considerable activity in the extension of this idea. This pamphlet gives adequate consideration to all of the modern devices. *Write to Scientific American for Bulletin 6A.—Gratis.*

THE TENNESSEE VALLEY AUTHORITY, 1934. 8 pages illustrated. *Tennessee Valley Authority, Knoxville, Tenn.—Gratis.*

MARKET FACTS ABOUT THE SPOKANE COUNTRY AND THE PACIFIC NORTHWEST. This is a valuable publication which gives information relative to the Spokane area and includes the Grand Coulee Dam, which is of considerable importance. *Review-Chronicle General Advertising Bureau, Spokane, Washington.—Gratis.*

EUGENIC STERILIZATION

(Continued from page 19)

seven children and we are getting half-orphan aid from the state for them." (In California this is 10 dollars per month per child.) "We have always figured that when we had two more children we would get enough for them so my husband could stop work and we could live on the income, so it would be too soon for me to be sterilized now."

In case of any doubt, the patient should be given the benefit of the doubt and sterilization not be applied compulsorily. There are enough eager candidates for voluntary sterilization in the United States to keep all the institutions busy for many years without taking those as to whom there is a possible question.

The operations in California have been divided about equally in numbers between men and women. The operation on the male is an extremely simple one involving a slight incision on each side of the scrotum, picking up, cutting and tying the very small tube through which the sperm pass, after which the patient can, if necessary, go about his work without any further inconvenience. The operation is bloodless, may be done under local anesthetic, takes onlv 15 or 20 minutes, and complications are almost unknown.

The operation on the female is a major one involving a general anesthetic and an opening of the abdomen. It is, therefore, comparable in gravity to an easy operation for chronic appendicitis. The fallopian tubes, through which the egg cells must pass on their way from the ovary to the uterus, are cut and tied and no effect is produced in any way on the patient's physical life. Menstruation, for instance, is not affected. But the patient must rest in the hospital for at least 10 days while the muscles are growing together again, hence the expense of a hospital stay is added to the expense of surgery. In voluntary cases, therefore, it is often preferable to sterilize the husband instead of the wife if the same object will thereby be attained.

One of the questions which most interested us in our investigation of the California sterilizations was whether or not the sterilization of unstable or irresponsible persons would create other serious diffi-

culties by putting a premium on promiscuity and therefore tending to promote the spread of venereal diseases and the disintegration of the monogamous ideal.

This objection seems plausible and has often been used by those who have had no first-hand observation of the facts. To the student of the mentality of these people, who are irresponsible and lacking in foresight and self-control, it is plain that in any case they could not be expected to take much thought of future pregnancies. Our survey sustains this conclusion. Of the feeble-minded girls sterilized at the Sonoma State Home and afterward paroled, 75 percent had been sex delinquents before commitment. After sterilization and parole, only 8 percent of these girls, or one in every 12, became a sex delinquent; and even these few, being under careful supervision, were for the most part at once detected and returned to the state home.

This great improvement in their conduct was, of course, not due to any change in their sexual lives brought about by sterilization, because it produces no effect of that kind. It was due to training in the institution, better mental and physical health, and parole under careful supervision in surroundings where it was as difficult as possible for them to get into trouble. On the other hand, from the California point of view, this parole was possible only because of the previous sterilization. Without sterilization these girls would simply have married, as a large part of them did anyway, and would have produced another group of defectives and dependents for the taxpayers of the state to encounter in the next generation.

MARRIAGE after sterilization, on the other hand, promotes in many instances the best stabilization of girls of this type, who can get along with a little help and supervision if they do not have the responsibility of children. Both husband and wife can work and therefore can support themselves even though both are inefficient economically. If, however, the wife had borne a steady succession of children, the earnings of the husband would have been inadequate to support the family. They would have gone on the county charities and finally, to judge by experience in other cases, the husband would have become discouraged and with the advent of a new pregnancy would have simply deserted, leaving the taxpayers to assume the entire responsibility for the wife and children.

A careful canvass of the Medical Superintendents, parole and probation officers, social workers and others who have had first-hand contact with sterilization in California, showed them to be unanimous in approval of the law and brought to light no instance of its abuse.

Sterilization is not a panacea, but in the light of California's experience, it appears to be one of the many measures that are indispensable in any far-sighted and humanitarian program for dealing with society's tremendous burden of mental disease, deficiency, and dependency.

•

The above article is the second of a series of three on sterilization. The third, presenting the point of view of the opposition, will appear within two or three months.

Books SELECTED BY THE EDITORS

THE ARCHITECTURE OF THE UNIVERSE

By W. F. G. Swann, D.Sc., Dir. Bartol Research Foundation, Franklin Inst.

UNDOUBTEDLY this is an outstanding popular book, the author being an outstanding physicist known the world over. In its 424 pages it covers the newer physics: the nature of matter, atomic theories, relativity, space and time, and the cognate corners of modern science. The 50 pages of it which this reviewer read were bright, witty and fascinating, but he bogged down and gave up the ghost after fighting through that much. The reason was that the paragraphs are interminable—one page, two pages, even six and seven whole pages in length, unrelieved and solid. The effect, not noticed at first, is cumulative—like plowing hour after hour through heavy sand and every now and then coming up standing, breathless and gasping for air. What a pity to load so clever a text with so heavy and needless a disability. We heartily recommend this book to those who think the purpose of frequent paragraphing is purely ornamental.—$3.95 postpaid.—*A. G. I.*

THE WORLD COURT—1921-1934

By Professor Manley O. Hudson

A CLEAR impartial story of the court's work including a presentation of the history of the proposal for American adhesion to the court. A reference handbook for the study of documents and other basic data.—Cloth $2.65 postpaid; paper, un-indexed—85c.

ROMANTIC COPPER

By Ira B. Joralemon

A CHRONICLE of greed, ambition, and miraculous discoveries, of comic rivalries and tragic failures. A rapidly moving, robust story of copper from ancient Cyprus to the sensational development of Butte.—$3.20 postpaid.

INDUSTRIAL RADIOGRAPHY

By Ancel St. John, Ph.D. and Herbert R. Isenburger

THIS is a compact, practical working treatise on the use of X rays for the study of flaws in castings, welded vessels, forgings, small parts and other articles, and is mainly for the engineer. It is not just a collection of interesting generalities but it actually tells how to do things—how to make the installation, the exact procedure in use and, in short, the kind of every day things the actual worker must know. There are accessory chapters on the development of X rays, their nature and properties, also on cost data, radiography with gamma rays—the whole picture. It has 70 illustrations, 181 text pages, tables, and an exhaustive bibliography, and is nicely produced, with a rugged binding that will stand kicking around the shop or laboratory.—$3.70 postpaid.—*A. G. I.*

ALCOHOL, ITS EFFECTS ON MAN

By Haven Emerson, M.D.

IN this compact 114-page book a professor of public health at Columbia University tells us a few favorable things about alcohol, together with so many unfavorable ones that a man who is really honest with himself will no longer have a leg to stand on after reading it—unless he simply declares that he drinks, not for the good it will do him, but because he likes it and that's that. If you like to argue about firewater and want some really scientific, approved ammunition with which to knock down your opponent, or if you merely want to know what scientists (most of them, anyway) think about alcohol, here it is, all regimented and systematized in this pocketful. It is a sane, calm presentation, with more light than heat—no ranting.—$1.15 postpaid.—*A. G. I.*

THE STORY OF ENERGY

By Morton Mott-Smith

AN authoritative, concise, and easily understood book rounding out the popular treatment of mechanics and energetics begun in two earlier works ("This Mechanical World" and "Heat and Its Workings").—$2.15 postpaid.

HEREDITY AND ENVIRONMENT

By Gladys C. Schwesinger

THIS is a book for the student rather than the average reader and it is very scholarly. It contains a study of the genesis of psychological characteristics and bears largely upon the measurement of intelligence and personality. It takes up the problem of heredity and environment from a new point of view, examining and analyzing the data on intellectual similarities and differences of identical twins reared apart, children adopted into foster homes compared with their biological and foster relatives. The author is on the staff of the Eugenics Research Association and is a clinical psychologist.—$4.20 postpaid.—*A. G. I.*

WRITE IT RIGHT

By Ambrose Bierce

ON the proper use of words and correct diction, this volume is primarily intended for authors, editors, proof-readers, lawyers, clergymen, and educated students. Written by a master of style and with irresistible wit.—$1.10 postpaid.

YOU MUST RELAX

By Edmund Jacobson, M. D.

IF you wear yourself out more through nervous tension than actual work, as many do, the graduated exercises and self-disciplinary methods described in careful detail in this book should help you to reduce this kind of strain due to modern living. It describes relaxing, which turns out to be much—very much—more of a science than it appears to be on first thought. This little volume has been highly recommended by Walter B. Pitkin, author of the best seller "Life Begins at Forty."—$1.60 postpaid.—*A. G. I.*

SKY DETERMINES

By Ross Calvin, Ph. D.

SKIES as the source of moisture and heat have determined the mode of life of long forgotten people of New Mexico as well as that of the present ranchmen. A beautifully strange story of desert country affording a unique approach to the arid Southwest, full of delightful observations and experiences of the author.—$2.65 postpaid.

For sale by
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New York City

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Attempted Dress Copyrights Fail

PIRACY in any form is to be deplored. Where existing legislation is inadequate to meet the needs of modern merchandising, new laws should be enacted.

Attempts have been made recently to have the Federal Courts broaden, in effect, the scope of our existing copyright laws. This, our courts properly have refused to do. Nevertheless, certain organizations operating under titles such as "Copyright Bureaus," and similar designations, have been circularizing the dress trade and associated industries claiming to be able to secure valid and substantial protection for dress and other garment designs by means of copyright. These concerns have secured for their clients a number of copyrights for *drawings* showing the dress or other garment supposedly protected, and have represented to the trade that the garment itself was protected by such copyright. Such representations are absolutely unfounded. They are based upon a misconception of the functions and theory of copyright protection. Design patent protection is one thing. Copyright protection is quite another. It is true, of course, that the drawings submitted to the Registrar of Copyrights present copyrightable subject matter as a *drawing or work of art*, and it is likewise true that anyone who copied that drawing would be infringing the copyright secured. It does not follow, however, that the dress or other garment shown in the drawing is protected. Objects of a utilitarian nature, such as garments, dresses, textile curtains, and similar items may be protected only by design letters patent.

The rules and regulations for registration of claims to copyright, notably Rule 12, are very definite and clear. Rule 12 states:

"The protection on productions of the industrial arts utilitarian in purpose and character even if artistically made or ornamented, depends upon action under the patent law * * *. Toys, dolls, advertising novelties, instruments or tools of any kind, glassware, embroideries, garments, laces, woven fabrics or similar articles are exempted. The exclusive right to make and sell such articles should not be sought by copyright protection."

Recently a great many concerns have been threatened with suit for alleged infringement of copyrighted drawings on the theory that the reproduction of the garment shown in such drawings was an infringement. Several suits were brought in the United States District Court for the Southern District of New York. In each case a preliminary injunction was requested by the plaintiff and in each case the defendant moved to dismiss the suit. In one of these cases, Judge Goddard in dismissing the suit stated:

"To give an author or designer an exclusive right to manufacture the article described in the certificate of copyright registration when no official examination of its novelty has ever been made would unjustly create a monopoly and moreover would usurp the function of Letters Patent."

In another case, Judge Knox had this to say:

"Whatever may be the defects of the design patent statute I do not believe that the complainant, by adopting the procedure here followed, can secure all the protection that a valid design patent would secure."

Under the present copyright law no protection may be secured for objects having a utilitarian purpose or character, and manufacturers or merchants should not be misled by the representations of these self-styled "bureaus" and copyright "companies" soliciting their business.

Chemical Patents

CHEMICAL patents issued in the principal countries of the world during 1933 aggregated 28,051, a record figure, according to a summary made public by Prof. E. J. Crane of Ohio State University, editor of *Chemical Abstracts*.

"The 1933 volume of *Chemical Abstracts*", Prof. Crane said, "contains 64,190 abstracts, representing new information of chemical interest appearing in scientific journals throughout the world as well as reviews of the chemical patents granted in the various nations. This is a gain of 6109 over 1932, the biggest year heretofore.

"There is, of course, a considerable lag between the time of application and the date of issue of patents so that the patents issued in a given year reflect, in part, activity of the preceding year or two. Even allowing for this there is reason for encouragement in the trend disclosed. The obtaining of patents is a form of industrial preparedness. They are an investment in the future. They suggest a live industry, potential growth, hopefulness, faith. Chemical industry has been keeping fit and it is not by marking time that it has been doing so."

"Simoniz"—"Lusterize"

IN a recent decision First Assistant Commissioner Spencer held that The R. M. Hollingshead Company, of Camden, New Jersey, is not entitled to register, as a trade mark for polish and polishing preparations for automobiles, the term "Lusterize" since that term is merely descriptive of the goods. He further held that the opposition could not be sustained because the term "Lusterize" is not confusingly similar to the mark of The Simoniz Company, of Chicago, Illinois, "Simoniz," upon which the opposition was predicated.

With reference to the similarity of the two marks, after stating that that question would be considered in view of the possibility of further appeal, and noting the holding of the Court of Customs and Patent Appeal that "Simoniz" and "Permanize" are confusingly similar, he said:

"Judging the two marks in their entireties, as must be done, it becomes at once obvious that they are a great deal more alike than are those involved in the case at bar. Thus, the marks 'Simoniz' and 'Permanize' are, with the exception of the suffix, substantially identical; whereas, the marks 'Lusterize' and 'Simoniz' are, with the exception of the suffix, entirely different. Thus, considering the marks in their entireties, it appears that there is no confusing similarity between them. To hold otherwise would virtually concede to opposer the exclusive right to the suffix 'ize' as a trade mark on an automobile cleaner and polish."

Bibliography of Inventions

AN excellent bibliography of publications in the German language relating to inventions and inventors, much too long to reprint in the limited space available here, appears in the May 1934 issue of the *Journal of the Patent Office Society* (Washington, D. C.). Prepared by Stefan Jellinek, examiner in the Austrian Patent Office, the list includes also works of a general nature dealing with the history of industries, and further, works dealing with outstanding engineers and manufacturers. Each publication or paper listed is described briefly in English.

"Air Washed" Bird Seed

IN *ex parte* The R. T. French Company, First Assistant Commissioner Spencer held that company, of Rochester, New York, is not entitled to register, under the Act of 1905, the term "air-washed," as a trade mark for bird seed.

The ground of the decision is that the term is merely descriptive of the goods and that it does not function to indicate source of origin.

With reference to the question of descriptiveness, the First Assistant Commissioner said:

"It is apparent from the record that in the preparation of the applicant's product the seeds 'are merely put through an air blower apparatus for the purpose of removing chaff and other intermingled foreign matter.' The term 'wash' means to cleanse by any effective agency and, accordingly, to characterize a product as being 'air-washed' is to indicate that it has been cleansed by air. Obviously and admittedly applicant's product has been so cleansed.

"In its brief, the applicant contends that 'the seeds themselves are not cleansed at all, in the sense that any adherent grime or dirt is removed from them.' It is not deemed pertinent or desirable to indulge in metaphysical arguments of this nature. The purchaser never does and it is his interests that are being protected in these proceedings."

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NINETIETH YEAR • ORSON D. MUNN, Editor

NRA CODE

CONTENTS · AUGUST · 1934

Cover

"THE machine has not betrayed us. We have betrayed the machine. . ." This is the essence of a statement by Dr. Glenn Frank, quoted in more complete detail in the editorial "The Century Ahead," page 65. Our cover picture, illustrative of man's dependence on machinery, typifies the wheels of industry. It was taken in the Chrysler plant, and shows one end of the huge stamping machines used in turning out fenders for the motor cars made in the factory so ably described by Professor Klemin in his article starting on page 61 of this issue.

SCIENTIFIC AMERICAN, August, 1934. Vol. No. 151, No. 2, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Copyrighted 1934 by Munn & Company, Inc. Great Britain rights reserved. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

SIR THOMAS LIPTON tried for many years to recapture for England the America's Cup, time-honored symbol of the best in the sport of yacht racing. Since the passing of that gallant sportsman, no challenger has appeared to question the supremacy of American yachtsmen until this year. Now, however, a worthy opponent has appeared on the horizon, and at the time of writing trials are being run to determine which of several American yachts shall be entrusted with the honor of defending the Cup. The Cup races themselves will be run in September, and the September number of SCIENTIFIC AMERICAN, available to readers in August, will carry a feature story of the details of the defender. We have arranged with Herbert L. Stone, editor of *Yachting*, to write this article for us. Mr. Stone knows yachts from stem to stern, from keel to masthead, and is in a position to give accurate and authentic information in an interesting and informative manner.

●

"IN the new Germany today, laws are being enacted which are designed to a large extent for the benefit of future generations, and usually with no regard for the approval or disapproval they may now find. In Germany all thinking and planning has as its aim the improvement of the health standards of the people through the application of biological science. May it not be that the sufferings and sorrows of the Germany of the past, of to-day and to-morrow may sooner or later become the concern of any other nation?" Thus is introduced an article on human sterilization from the German point of view, the third in our series, prepared especially for us by a prominent German physician. Regardless of what one may think of the politics of Germany, it must be admitted that she is making a brave struggle for existence; in this article the matter of sterilization is reduced to a matter of dollars and cents—or rather of Reichsmarks—a powerful argument in times of economic stress.

●

ON page 82 of this issue starts an article entitled "Why the Battleship?" In it, Commander Jonas H. Ingram indicates the place of the battleship in the line of national defense, and shows how incomplete a navy would be if these dreadnaughts were eliminated from the fleet. Next month Commander Ingram will take up more specifically the battleship itself and its actual functions, thus rounding out an excellent answer to those more superficial thinkers who would ruthlessly junk all existing naval ships with the exception of submarines and airplanes. The two articles by Commander Ingram will enable our readers to follow more intelligently the international naval arguments which will appear in the newspapers in the future.

NEXT MONTH

¶ The defense of the America's Cup, By Herbert L. Stone, editor of Yachting.

¶ Donald A. Laird, Ph.D., on sleep and sleeping.

¶ An official statement regarding Germany's experiment with human sterilization.

¶ An advanced article on sun dials.

COMING

¶ The case against human sterilization.

¶ Details of the big guns which guard the Panama Canal.

¶ How 91 miles of 18-foot aqueduct tunnel are being bored through the mountains of California.

●

WHAT kind of bedroom would you select as being more conducive to sound and restful sleep? A bright, cheerful room with frilly curtains and modernistic decorations on the dresser? Or spartan simplicity in a room with windows which can be flung wide to the four winds, and little or no decoration? According to Dr. Donald A. Laird, Director of the Colgate University Psychological Laboratory, you would be wrong no matter which of these extremes you selected. Indeed, says Dr. Laird, in an article scheduled for early publication, "if you would keep good health and spirits . . . make the sleeping room like a bear's cave—blue and green with deep shadows, sheltered from outer noise as with woodland leaves . . . and completely free from vagrant air currents which cause even the gentlest motion of, and therefore sound from, curtains, calendars, lamp shades, and other ornaments . . ." Many of your preconceived ideas regarding sleep are going to be upset by this article, backed by scientific research.

●

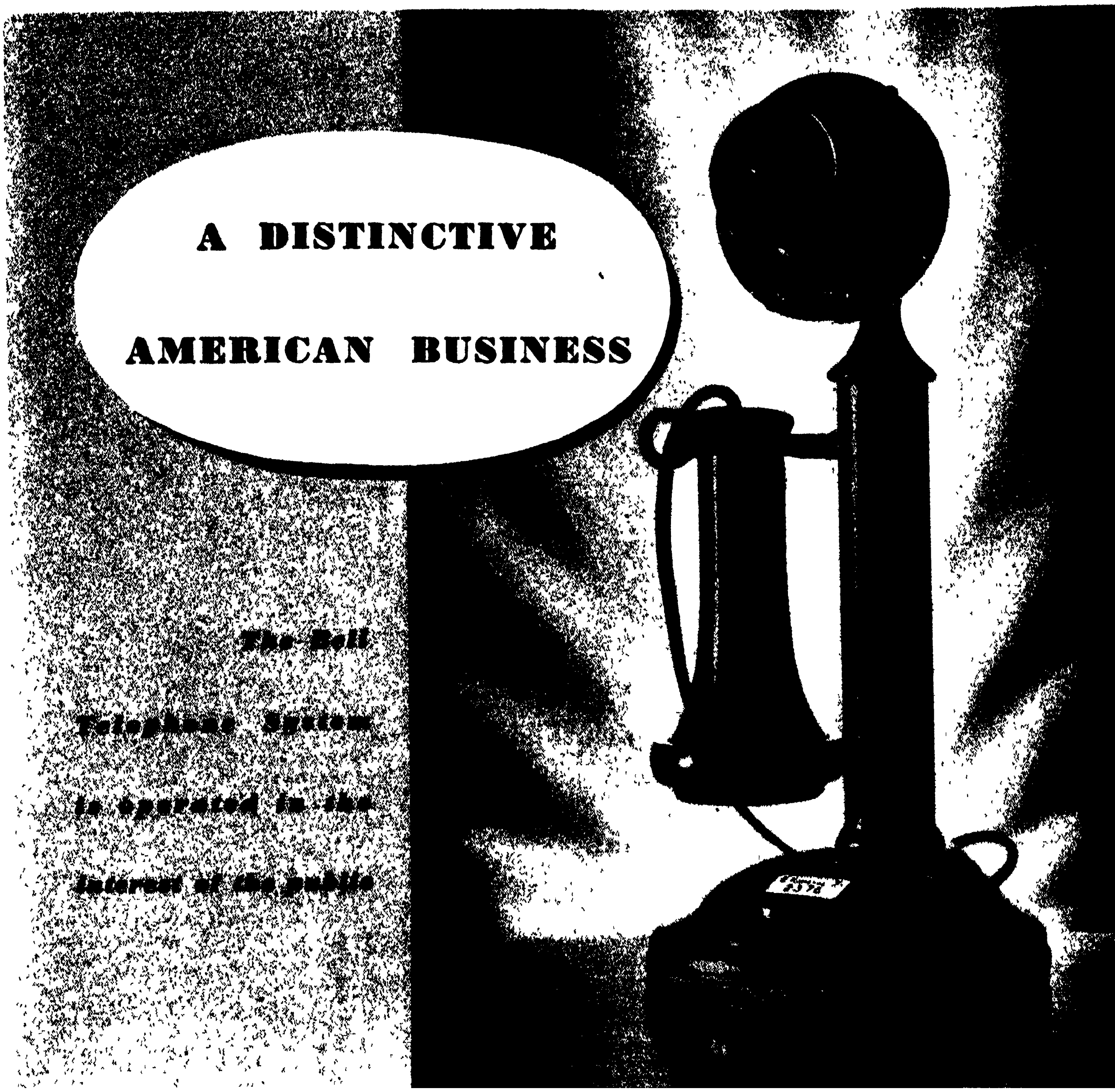
AFTER ten years of work on the great Coral Reef Group, which is now approaching completion in the Hall of Ocean Life in the American Museum of Natural History, New York City, Dr. Roy Waldo Miner took his fifth expedition to the Bahaman coral reefs in order to make another underwater study and to compare the artificially colored corals that will be used in the group with the natural growths. Dr. Miner will describe his work in an article to be published soon, accompanied by a series of striking photographs taken by the expedition. When finished, the Coral Reef Group will be the equivalent of 30 ordinary museum groups in size and will occupy one third of the entire end of the Hall of Ocean Life, which is itself probably the largest museum exhibition hall in the world.

●

IN the second and final part of the article on "Excavations at Ur," the first of which starts on page 66 of this issue, Prof. C. Leonard Woolley continues his absorbing story of the recent archeological finds in Chaldea. There civilization has been traced back to the time of the Great Flood, and under the flood deposits have been found remains of the antediluvian inhabitants of the country. Professor Woolley's graphic descriptions of the finds that have been made, and the conclusions drawn from them, give to the reader all the mental stimulation that is such an important part of archeological exploration.

Orson D. Munn

Editor and Publisher



THE Bell System is a widely owned organization operating a public service under federal and state regulation.

Its threefold purpose is to give the public the best telephone service at the lowest possible cost, give steady work at fair wages to its hundreds of thousands of employees and pay a reasonable return to the men and women who have invested in it.

The constant endeavor of the management is to deal equitably and honorably with each of these groups. There is no reason to do otherwise. There are 675,000 people who own the stock of the paren company—American Telephone and Telegraph. The are the owners of its nation-wide property. They ar your neighbors. They live in every state of the Unio and their average holding is twenty-seven shares. N individual or organization owns as much as one pe cent of the stock.

In the truest sense, the Bell System is a busine democracy—born in America, brought to its prese stature by American enterprise, financed and operate by and for the people of America.

BELL TELEPHONE SYSTEM

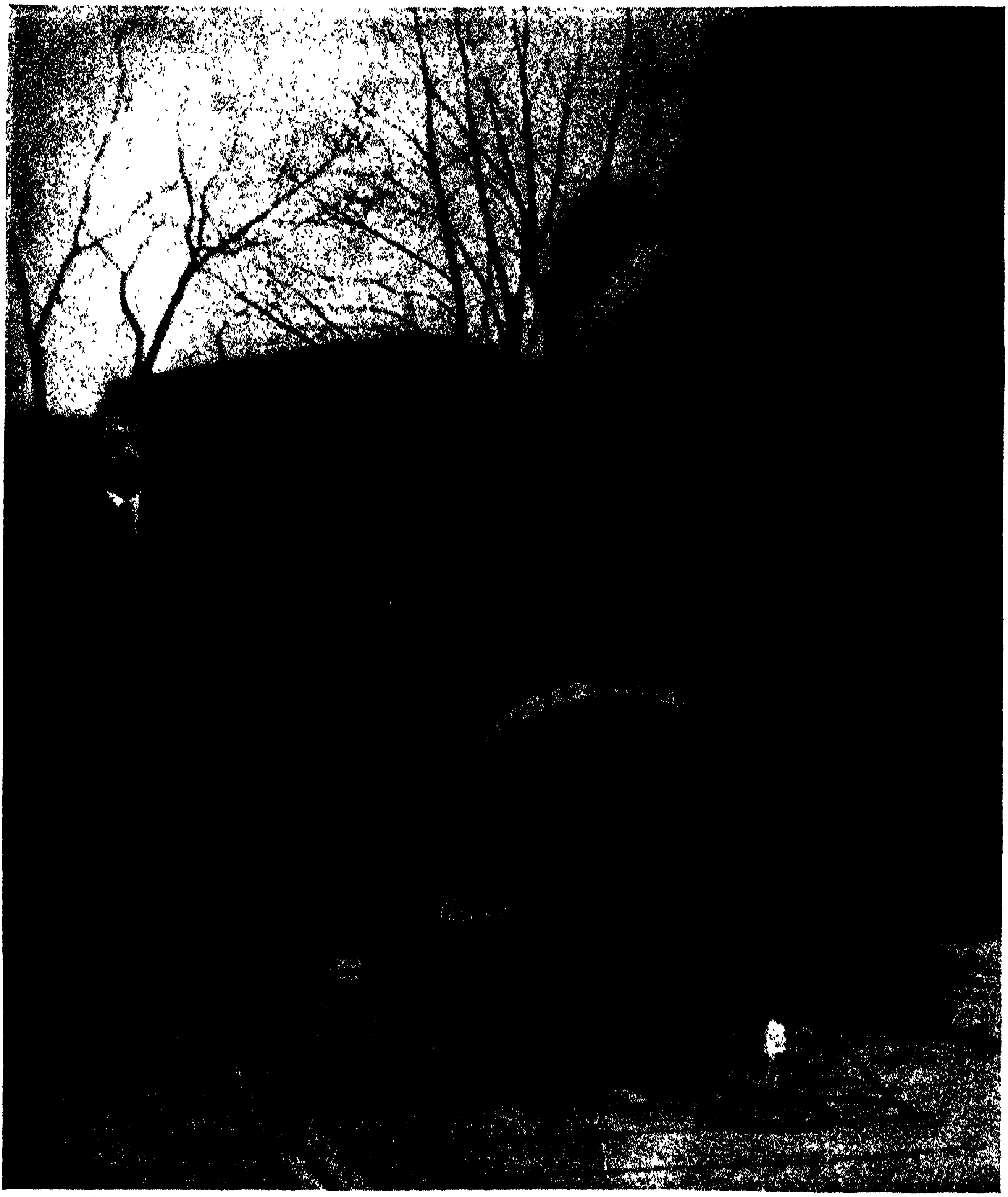


Photo by Gerald E. McCord

THE LINK BETWEEN ARCTURUS AND THE FAIR

As is widely known, the illumination at the Century of Progress at Chicago was last year turned on each night by means of rays of light from the star Arcturus, caught by a telescope at Elgin, Illinois, and converted photo-electrically into electrical impulses which were sent by wire to the Fair and amplified to operate relays. The same telescope is this year set up in the court of the Hall of Science at the Fair. This telescope is shown above with its maker and owner, Professor Arthur Howe Carpenter of the Department of Metallurgy at the Armour Institute of Technology. It has a 20½-inch mirror.

©Blank and Stoller
Walter P. Chrysler

A research triumvirate famous in automotive circles. *Left to right:* Fred Zeder, Carl Breer, and Owen Skelton, who have developed a definite philosophy of research in industry

How RESEARCH Makes Possible The Modern MOTOR CAR

By PROF. ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University
Associate Editor, *Scientific American*

IT may be safely said that those American industries thrive and advance which carry on research wisely and effectively. A recent visit to the Chrysler Engineering Laboratories gave striking confirmation of the truth of this statement. There is no industry more progressive than the automobile industry; no major factor in this industry better aware of research possibilities than Chrysler.

A reader of advertising matter might form the conclusion that Walter P. Chrysler, working with a few able men, produces a new design as a matter of pure inspiration. Chrysler is a broadly trained engineer who works along original lines and who inspires and gives full scope to able designers and investigators, but the creation of a new model actually comes as the result of arduous and patient effort, original and thorough research, followed by the most careful experimental construction.

MODERN technology provides abundant weapons for every type of research and experiment. Scientific instruments and apparatus, experimental machine shop practice, chemical and physical laboratories, methods of mathematical analysis, have all been developed to such a pitch of flexibility and perfection that these ends are today almost taken for granted; what is much more important in industrial advance is personnel and philosophy of research.

Prior to a fascinating and rather overwhelming visit to the laboratories, the writer of this article spent a few pleasant hours with the Chrysler research "triumvirate" to see whether a philosophy of research did indeed animate the organization.

The triumvirate is famous in automotive circles. Fred Zeder is rugged, impetuous, full of indomitable courage and vision, a graduate of the University of Michigan, who has driven a locomotive and uncoupled freight cars. Carl Breer, a Stanford University graduate mechanical engineer of wide experience, is above all observant and imaginative. Owen Skelton, an equally capable engineer, is calm and steady—the balance wheel. That the views of these men on industrial research have ever been set down in a cold formal document is as unlikely as that the British Constitution has ever been deliberately written. Nevertheless they do have a definite philosophy—coherent, clear, and applicable to every branch of industry.

Every piece of industrial research must be based on a definite hypothesis. The hypothesis must derive not from idle speculation or mere wishfulness, but from observation, service records and experience, the systematic study of public opinion, or the lessons of other fields of applied science. Granted that the fundamental hypothesis is sound in principle, no difficulties of execution can be allowed to stand in the way of realization. A sound and desirable mechanical or scientific idea can always be realized, given sufficient courage and persistence. Mere research for re-

28(17/'36


Automobile engines undergoing severe tests in the "cold room"

search's sake is inadmissible in an industrial laboratory. The invention, experiment, or research must serve some definite commercial purpose. It must be put into a definite project form, pondered over, carefully outlined and budgeted like any other business undertaking.

In the selection of men for carrying out a given investigation, their personal preferences and interests should serve as a guide. In actual practice this means that departments are flexible and that various problems to be solved are allotted to those men who express in conference the greatest and most intelligent interest in such tasks. Further, although a budget and a general plan are essential, a line of research should be pursued with perfect flexibility and with no red tape.

This is a working credo which might well serve many another organization. It is faithfully lived up to by the triumvirate and the several hundred picked men who work under its direction.

IT is of interest to classify roughly the main objectives of modern automotive research. Such a classification can never be complete and will vary from year to year. Progress is never entirely a matter of rigid planning, and has an evolutionary growth which is sometimes a matter of accident, circumstances, discoveries in other fields, brilliant inspiration. Nevertheless it may be said that for the time being there is a concentration of interest along the following topics. First, increased speed or, alternatively, increased economy of operation at a given speed. Second, improvement of passenger comfort, as by the elimination of vibration and by a more thorough understanding of automobile dynamics.

Next there is a constant striving for greater safety and reliability. Metallurgical improvements and the use of special materials such as rubber are given constant thought. The application of the principles of industrial art to the automobile occupies the minds not only of specialists but of all the key men concerned with automobile design. Last but not least we find a vital interest in the problem of the selection and practical education of its present and incoming personnel.

This approximate subdivision of activity will serve as a guide in our brief survey of the research activities of this energetic, typically Detroit association.

PERHAPS the most interesting problem tackled in recent years by this group of engineers is the streamlining of the motor car. The inception of the present car is an illustration of the triumvirate's philosophy that progress comes from observation and imagination. Several years ago Mr. Breer, riding in a car near Port Huron, saw a formation flight of Selfridge Field pursuit planes. It occurred to him that it was a wonderful thing to see a heavily loaded, fully equipped army plane supported by thin air. Evidently the lift of air was powerful. Perhaps air force could be applied, not to lift a car, but to press it down more firmly on the ground at high speeds, and increase the steadiness of fast riding.

Rudimentary experiments indicated that the lift of an automobile was a negligible affair, but that the air drag was far greater than commonly estimated. Why not reduce the drag by streamlining? (It is curious to see here an instance of what frequently happens in research: An apparently erroneous conception leading in the hands of intelligent men to a correct and truly important development.) The streamline car did not then suddenly emerge. Hundreds of experiments conducted under the capable direction of Mr. Breer, first in a very small wind tunnel, then in a larger tunnel with frequent checks in still larger university tunnels, led to the best form that could be employed, with due regard to all the other requirements of the automobile.

It is a sophisticated thing to say that the Airflow car is not fully streamlined. Any aerodynamicist could in a very short time produce a number of shapes apparently fit for automobile use and having much less air drag. But in applying such streamline shapes it would very soon become apparent that compromises have to be made. For example, it is impossible to enclose the front road wheels, which must of necessity swivel. It is impossible to give the car an airship bow if the engine is to be placed in front and passengers at the same time are to be given perfect vision. It is impossible to lengthen the body indefinitely into fish tail form and still have a car which is practicable in congested traffic. Thus the Airflow car is an engineering compromise between ideal aerodynamics and practical automobile design.

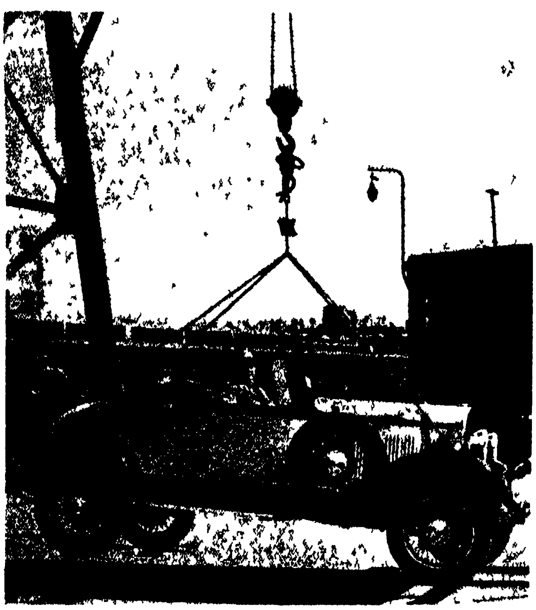

The chemistry laboratory of a university founded within the walls of an industrial plant

NOT so many years ago rigidity and great weight were considered essential in all forms of heavy engineering where varying forces and moments were encountered. In vehicles of transportation it was thought necessary to have immense weights, such as are still found in our steam locomotives and heavy Pullman cars. The heavier and larger the automobile, the steadier and safer it was supposed to be on the road. To a certain extent mere weight did eliminate vibration and give steadiness, but this meant expensive construction and

wastefulness in operation. With the growth of a new science—vibration engineering—we find a totally new tendency. It is now sought, whether in the automobile or the railroad train or even the prosaic trolley car, to eliminate vibration by more subtle methods and by a better understanding of applied dynamics.

Vibration dynamics starts with such readily understood phenomena as the swing of a pendulum and the oscillation of a spring with a weight suspended from one end. It ends with the mathematically complex problems of an automobile comprising an engine with varying torque impulses; powerful inertia forces occurring at varying times; mass distribution which must satisfy requirements other than those of vibration; springs which must be strong yet yielding; bumps in the road which encounter but one wheel at a given instant.

One of the leading exponents of modern vibration engineering is R. K. Lee, in charge of special research. The elimination of vibration has been with him not the result of sudden inspiration but of many years of purposeful effort.



The entire weight of the car is suspended from a rubber block between steel plates, showing strong adhesion of rubber to metal

It is impossible in this article even to outline the science of vibration. It is interesting, however, to mention some of the weapons employed.

First of all has come mathematical analysis. The equations of motion have been solved not only for the simple pendulum and the oscillating spring but for the complex dynamical systems of the motor car. Masses and their distribution moments of inertia, restoring forces, damping forces, centers of gravity, were all taken into account and the mathematical problem solved.

For the determination of the elements involved a number of devices were employed. For example, an entire engine was swung on ball bearings like a huge pendulum. From the observed time of swing it is possible to determine the moment of inertia of the engine. From its position of equilibrium the exact location of the center of gravity has been found.

In the study of engine torque impulses, the tortiograph was employed. This is a machine which is clamped on the front end of a crankshaft. One part of the tortiograph follows implicitly the vibration of the engine; the other has a smooth rotary movement. By means of reflected light the instrument traces on a photographic negative the relative displacements between the two parts and hence gives a faithful picture of the torsional oscillation of the engine.

It is, therefore, the result of a truly scientific approach that the dynamics of vibration has been mastered in the modern automobile. Here, in brief, are the various ingenious developments which have given us easy riding cars of light weight and few engine cylinders.

First there is Floating Power with which every reader is familiar. The second outstanding achievement lies in the production of a perfect torsional damper. Between the front end of the crankshaft and the front bearing a rubber disk receives all the moments from steel to steel. The use of rubber as the sole connecting unit is made possible by the perfect adhesion of steel to rubber (a matter we shall come back to a little later). The interposition of a damping element such as rubber took out torsional vibrations, as shown by tortiograph records.

The next line of attack was in the distribution of masses in the streamlined car. The mass of the engine now rests squarely over the front axle; other heavy masses are over the rear axle. This is entirely logical in itself—heavy weights should lie as closely as possible to the points of support. There is another great advantage, however, in this spreading out of the masses from the center of gravity—the moment of inertia of the car about a transverse axis is greatly increased. This makes for a much slower period of oscillation in pitch and therefore more comfortable riding.

Again, because of streamlining, the passengers were moved considerably forward in relation to the rear axle and hence were placed much nearer to the center of gravity. Every experienced ocean traveler likes to have his cabin as near the center of gravity of the ship as possible, where motion is reduced to a minimum. In the Airflow car considerations of streamlining and of dynamics combined to give the occupants an ideal location.

Of course, this treatment of the vibration and dynamics of the modern car is superficial and touches only on a few of the "highlights." A serious study is not as difficult as a study of Einstein's Theory of Relativity, but requires nevertheless a rigorous mathematical and experimental approach.

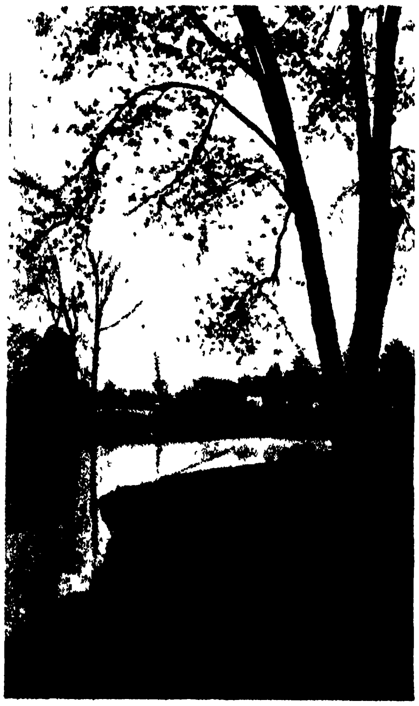
One of the most interesting phases of our visit was the inspection of the mechanical laboratory, under the guidance of the Chief Engineer, Harry Woolson, whose motto is evidently "safety through destruction." No matter how carefully a part may be designed, no matter how well selected the materials employed, the ultimate safeguard lies only in indefinitely repeated

(*Please turn to page* 107)

The Belgian Roll subjects a car to greater stresses than the roughest of roads

COMPOSING A PICTURE

By F. D. McHUGH



An excellent composition: a tree dominant and a bridge subordinate

Courtesy Eastman Kodak Company

The same scene artistically softened by the use of a light-diffusion disk

TO the rank amateur, scenic photography is a simple matter. To the more advanced photographer, however, the problem becomes one of full appreciation of the various elements of a projected picture. Very often the advanced amateur will study a certain scene for hours, and sometimes will revisit a scene for days endeavoring to catch the lighting or cloud formations that will bring out most effectively the principal features of the composition. Often a pocket reducing glass is valuable for this job of composing because it will reduce and concentrate the entire picture to a closer approximation of its final size on paper.

The great secret of artistic work is simplicity, the avoidance of overcrowding, and the employment of the fewest lines and masses in the composition of your picture. Harmony and balance rank next in importance. Usually human figures fail to harmonize either in costume or pose with the subject. Domestic animals—horses, cows, sheep—can, however, frequently be introduced with success. If you must use human figures do not let them look directly at the camera, and see that they harmonize in every way.

Naturally there should be a reason for making your picture. It is made to preserve a record of some interesting place, some picturesque grouping of natural or man-made objects or both, to picture the beauty of some bit of land or sky, or to produce a picture which appeals to the observer purely because of its innate beauty of line or tone.

Composition is not an exact science that can be depended upon mechanically to produce results. We can, nevertheless, apply general principles that will aid us materially in avoiding the inartistic.

Bringing things together in an orderly and symmetrical arrangement is perhaps as good a definition of composition as any other. Selection naturally precedes composition and the first lesson to be learned is to leave out what is not required. A good rule is to seek first a good foreground—one that will lead the eye unobtrusively yet pleasantly up to the principal object in the picture. Choose your viewpoint carefully, for while the painter can eliminate what he desires, you have the advantage of being able to move your camera where you wish to secure the effect you desire.

YOUR picture must have a dominant figure or object to which all other parts of the picture must be subordinate. An object of secondary interest should be included for balance. For example, if your principal object is a clump of trees, a second clump a little farther away, or perhaps a woman playing with a child or watching an incoming boat —this constitutes the motif of your picture.

Remember always that the background must be subordinate and unobtrusive, also that there should not be two highlights or deep shadows of equal importance and that when possible the deepest shadow should meet the highlight. Furthermore, the most important position in a picture is towards the center either to the right or left. The exact center should always be avoided.

Of equal importance with the arrangement of the objects in your picture is the question of lighting, as the lighting determines the strength and position of lights and shadows. Beginners as a rule should have the sun behind the back or over the shoulder but the advanced amateur will try for more unusual pictures. He will frequently make photographs with the sun to one side and sometimes may enhance the value of his picture by having the sun in front of him—with the lens shaded of course!

The horizon line, usually so conspicuous, should never divide the picture into two equal parts, but should be approximately one-third from the top or from the bottom. When this line is nearer the bottom, clouds in the sky are a decided advantage although to photograph them a filter is usually necessary. (The technique of using filters will be the subject of our photography article next month.)

The shadows should also have careful study. These should be transparent to a degree, always containing detail. Heavy black shadows are a detriment. When the sun is very bright and the lights are strong while shadows are black, the snapshot usually gives too great a contrast. This can be overcome with a very short time exposure and small diaphragm opening, resulting in a softening of the highlights and added detail in the shadows.

It used to be that most landscape photographers wanted "hair line" sharpness in all pictures. Now, however, softer lines are often preferred. As the amount of diffusion is governed by the size of the lens stop used, the effect desired can be easily obtained in certain subjects. Exactly the right degree of diffusion can be secured by using a diffusion disk over the regular camera lens.

OUR POINT OF VIEW

The Century Ahead

IS the world finished? Have we reached the pinnacle of progress already, with nothing outstanding ahead of us? The Glooms would have it so, but 500 leaders in science and industry believe otherwise; and, in no uncertain terms, proclaim, by inference, that today is our period of adolescence. They say the 21st Century will be the "Coming-of-Age" Century of mankind.

The occasion for the expression of this philosophy of achievement was a meeting in the Hall of Progress in the General Motors Building, Century of Progress Exposition, to which these 500 specialists were invited by Alfred P. Sloan, Jr. Were it not for the fact that these men are all hard-bitten realists who deal in facts rather than dreams, one might be inclined to suggest that they had allowed their imaginations to run away with them. Their predictions of what we may expect in future years were so amazing as to be almost beyond conception.

Such fields as housing, transportation, medicine, education, communications, radio, television, new consumable products, and new useful services came within the range of discussion by these learned men. One by one they spoke, and all agreed that science and industry are on the threshold of great achievements.

Airplanes will be powered from stations on the ground. Electric motors will run by sunlight. Infectious disease will be eliminated. Regular trans-oceanic airplane schedules will be run. Slums will be wiped out by low-cost pre-fabricated houses. Man will live to the Biblical three-score years and ten. All houses will be air-conditioned. Facsimile radio will "manufacture" your "newspaper" in your home. These are but a few of the suggestions of what developments to look for in the next decade, according to various authorities at the meeting.

SCIENTIFIC AMERICAN is thoroughly in accord with the statements of Mr. Sloan and others condemning the defeatist attitude that has, of late, become so prevalent. We have often voiced our opinion forcefully on that score. Dr. Glenn Frank, President of the University of Wisconsin, however, expressed this progressive viewpoint so clearly that we shall quote him:

"The machine has not betrayed us. We have betrayed the machine. Science and technology have given us the means by which we may emancipate the race from poverty, drudgery, and insecurity. If we now prove incapable of using these means to the full, the verdict of history upon us will be that we were a people strangled by our own success."

Progress has only just begun; we will *not* be forced to divide jobs at present available in order to live; and we will *not* be faced with acceptance of a lower standard of living.

Super Alchemy

IT took chemistry hundreds of years to discover in Nature all of the 92 chemical elements which Mendeleeff was able to predict in advance, through his great generalization, the famous periodic table. Now the Italian physicist Fermi has given us Element 93. Does this mean that, with Nature's normal 92 elements already found, we are at the beginning of a new series of discoveries of super-elements higher in atomic weight than those already known?

It has long been stated in a loose sort of way that there is no known reason why Nature stopped at 92, and that this number may represent only her liberality in that part of the universe with which we are familiar. Elsewhere, under different conditions, the scale might go higher, it was thought. But most of those who expressed such thoughts were not expressing real opinions—instead these were little more than logical speculations which could neither be proved nor disproved and hence were allowed to stand unchallenged. More recently, however, Sir Arthur Eddington, on better than merely speculative grounds, has expressed the belief that the number of possible elements is 136.

It must be kept clearly in mind that the new "discovery" (which was actually a man-made synthesis) of Element 93 had nothing to do with the earlier predictions. It was the logical outcome of research done recently by the French physicists, Irene Curie Joliot (daughter of the Madame Curie of radium fame), and her husband, Professor F. Joliot. These two announced early in the present year that they had created forms of nitrogen, silicon, and phosphorous by bombarding the nuclei of boron, magnesium, and aluminum with the cores of helium atoms. These elements of higher weight were thus synthesized from elements of lower weight, but they did not "stay put"—they proved to be radioactive and transitory. What the Italian physicist has done is really of a piece with their work.

Now that it has been done, what of it? Shall we some time be able to do something with it, run something, cure something, or tax it? The answer is, we do not yet know. Certain it is that "useless" discoveries of the past have almost always turned out to be extremely useful in some unexpected way—if for nothing else than as an approach to other discoveries which are useful. The world must wait and see.

Airplane Fatalities

TWO fatal air-transport crashes within ten days; three since the airlines recovered the carrying of mail; six crashes in all during the same period, three of them being of lesser importance but still serious enough to cause comment. This has been the recent record of the air transport lines—twice as many fatalities as during the last six months of 1933.

SCIENTIFIC AMERICAN has frequently published articles telling of achievements in aeronautical engineering, often stressing the safety features to be found on modern aircraft. But all these advances are to no avail unless installed by the operators and used by the pilots. All of the crashes mentioned above were associated with bad weather, but the highly developed weather reporting system now in use should seemingly be sufficient to permit pilots to avoid storm areas or to keep to the ground until weather conditions were safe for flying.

It is possible that economics effected in operations, together with too severe competition, have caused planes to be sent into the air when conditions were not right. If this is so, more rigid control of air-transport companies should be exercised in the interest of public safety. If operators are going to continue to order planes to fly against what should be their better judgment, they should be held strictly responsible for their acts.

In the past, the results of investigations of aircraft accidents have not been published; the Rayburn bill, which should have the support of everyone concerned with the future of aviation, will make such publication compulsory. Then and then only will the public be thoroughly informed of the facts.

In the meantime, air-transport operators should take advantage of every available safety device; if they fail to do so, they will betray their public trust and should be outlawed from their chosen business.

EXCAVATIONS AT UR*

By C. LEONARD WOOLLEY, M.A., Litt. D.
Director of the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia

WE have done so much work at Ur during the last 11 years that I cannot possibly attempt to deal with all that we have found, and it becomes a question of selection. I have selected not so much a subject as a problem. I suppose that any new discovery produces more problems than it solves, and certainly the discoveries that we have made at Ur have tended to set scientists by the ears rather than to satisfy them with the new information obtained. There are many disputed points and there have been many surprises. I suppose that in archeology, a minor science, few surprises in recent years have been so great as that occasioned by the excavation of the great cemetery lying beneath the ruins of Ur. I am going to say something about that cemetery and then raise one or two of the main questions which have already been disputed by people interested in the subject though not always as yet in possession of the facts. I shall try to show how important the cemetery at Ur is in its historical relations to what was its past and to what became its future.

The first thing that was found, which threw a light on what was going to be discovered, was a dagger, which became famous as the dagger of Ur. It is, I suppose, familiar to many people. The sheath, beautifully worked, is of solid gold, the blade is of gold, and the grip of the handle is one piece of deep blue lapis lazuli with gold studs. When it was discovered it was an absolutely unique object: nothing like it had been known to come from the soil of Mesopotamia, and so strange was it to science that one competent and highly experienced authority declared that it must be Arabic work of the 16th Century A.D. That it should be regarded as Sumerian work of about the 33rd or the 34th Century B.C. seemed almost incredible, yet subsequent discoveries showed that, so far from being unique, this dagger was characteristic of the civilization and of the period to which it belonged.

At the very beginning of the following season there was produced from the grave of a member of the royal house—not a king, but a commander of the forces—a remarkable gold helmet, formed from one solid piece of gold, in the shape of a wig, with all the locks of hair standing out in relief and the individual hairs represented by engraved lines. It was a work of such technical excellence that we found, to our regret, that it was impossible to get a copy of it made by hand for the British Museum, and an electrotype reproduction was the only thing possible, because the skill and steadiness of hand shown by the craftsmen of about 3300 B.C. is not possessed by the workmen of to-day.

A remarkable gold helmet, formed from a single piece of metal, found at Ur and dating from 5000 years ago

Another extraordinary technical quality of these old people was their skill in casting. One weapon that we found, cast, as a matter of fact, in electrum, exhibited unusually well the marvelous degree of skill attained by them. It is a technique which was not learned by the Egyptians until comparatively late in their history, yet here we find it fully developed, in perfectly modern excellence and refinement, at what might seem to be the beginning of a civilization.

A gold goblet that we found, curiously unoriental in its outline, would seem rather to be the work of a Greek craftsman than the work of a Sumerian of the fourth millennium B.C. The work is paralleled by other gold vessels, such as plain bowls with handles of twisted gold wire, perfectly simple yet extraordinarily good in form and finish. These gold vessels were often relieved by fluting and by engraved patterns, and the conscientiousness of the workmen of that time is well shown by the fact that they carried the pattern on to the flat base of the bowl, where it would never be seen. Although, of course, goldsmith's work such as this may have been equaled often and in many countries at a later date, yet it has never been surpassed. I think, at any date or in any country, simply because it is as good as goldsmith's work can be.

TURNING to the musical instruments of this time—the oldest of which we have any knowledge—we found lyres made of wood and overlaid with thin silver plate. One such lyre had its sound box made of silver outlined by a narrow strip of blue and white mosaic; down the front were plaques of shell with engraved mythological pictures, and projecting from it was an extraordinarily fine cow's head cast in silver. The sound box itself represented the body of the animal in a highly conventional form, a sort of Cubist art! There are later texts which draw a parallel between the animal represented and the tone of the instrument. Rising from the sound box were the uprights of the crossbar, and short silver-plated tuning rods or bars, now seen lying at different angles against the crossbar, were put through loops in the individual strings and twisted round to tighten those strings for the fine tuning. Another lyre was of a more fantastic and unusual design. The sound box was of silver over wood, in the shape of a boat, on which stood the complete statue of

*Courtesy the *Journal of the Royal Society of Arts*. Photographs by the Joint Expedition.

an antlered stag supporting one of the uprights. The tuning bars or rods in that case had presumably been made of plain wood, not silver plated, and had therefore disappeared, but on the crossbar bands of different color could be distinguished, some black and some light in color, the black bands being due to the effect on the metal caused by the decay of the canvas loops which came at the top of the strings and were put 'round the crossbar; it was through those loops that the tuning bars went and were twisted 'round. Another lyre found was of wood, largely overlaid with mosaic of an elaborate design, with shell, lapis lazuli, red stone, silver, and gold. At the base there was a gap in the mosaic pattern, above which were eight short vertical bars; this was the hole through which the eight strings were brought to pass over the bridge and up to the crossbar.

THE best of these treasures come from royal tombs, though some, of course, from private tombs. I want to mention now certain details of those tombs. I have mentioned the objects we have found, and I am now going to try to show the relevance of those objects to history, but it is important to know where they were and how they were found. When the king died, first of all a rectangular pit was dug, going down some 30 or 40 feet into the soil, open to the sky and approached by a sloping passage, which ran down from the ground surface to the pit's bottom. At the time of the funeral there came into that pit all the people whose privilege it was to die with the king, his retinue who were to carry on their service in the next world. Therefore we find at the bottom of the pit soldiers of the guard, wearing their copper helmets and carrying their spears. We find the royal wagons backing down the slope, each drawn by oxen, with the charioteers standing by the wagons. There are servants, officers, and so on, some of them distinguished in their rank by carrying bundles of spears of copper or of silver or of gold. In one place lie women wearing rich headdresses, and servants line the passage which leads to the top of the tomb.

With regard to the tomb, while an ordinary citizen of Ur was buried at the bottom of a pit in a coffin of wood or clay or basketwork, or, if he was a poor man, simply wrapped up in a roll of matting, a king or queen had two special prerogatives. In the first place, instead of being buried alone, they were accompanied to the grave by a whole retinue of followers, who shared their fate in this world and their fortune in the next. In the second place, instead of being laid in a mere coffin, their bodies were placed in a built chamber. In the case of one such chamber that we discovered, the walls were of rough stone thickly plastered with mud, so that the stone was invisible. The door of the tomb chamber was blocked up as it was left by the mourners when the king's body had been laid inside. The top of the door was built of burnt bricks in the form of an arch, and, looking over the ruined top of the chamber wall, there could be seen what remained of the chamber roof, which again was composed of ring arches in burnt brick forming a barrel vault, the end of that vault taking the shape of an apse. That is an astonishing thing. Any textbook on architecture is prone to say that the arch, the dome, the apse, and the vault are comparatively recent inventions. It is often said that they were due to and probably originated by the Romans. No earlier than 1924 Mr. Dalton, in his book on "Eastern Christian Art," suggested that the arch was derived from Babylon, remarking that the earliest example of it dated from the time of Nebuchadnezzar; he put that view forward in opposition to Strygowski, who said the origin of the arch was in the country of Armenia, whilst some writers had suggested Egypt as the source of it; none had ventured to give an earlier date. Yet here we have the arch and the apse found complete and standing, built in Mesopotamia in the latter half of the fourth millennium B.C.

IN another royal tomb, a tomb of a much more ambitious kind, there was a whole succession of chambers opening one out of the other, so that it really was a royal palace in miniature built

Aerial photograph of Ur. The Ziggurat shows near the upper right-hand corner. The landscape is barren and is covered by a noticeable system of stream sculpturing. Mesopotamia is not rainless, about ten inches of rain falling annually, mainly during the winter. In that season the temperature is about comparable with that of Arizona; in summer with that of Hades. Archeologists do their work in winter. The 12 years work of the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania, under the author's direction, has been finished and an elaborate book published. The Ur excavations far outrival Tutankhamen's tomb in historical significance. It now appears that civilization is more ancient in Mesopotamia than Egypt but the evidence is not yet wholly in. Long, long before civilization began in either place man lived as a barbarian or savage, his stone artifacts being found in Egypt and at Ur

underground. The limestone walls were originally well constructed and covered with a cement plaster which was burnished to the point of being lustrous. The chambers were covered with vaults of stone. In another instance our workmen dug down some 30 or 40 feet from the surface and laid bare a dome built with rough limestone blocks set in heavy stiff green clay. It is, I suppose, the oldest building erected by man which is still standing, with its walls and its roof complete, for it dates to about 3400 B.C., but a more important point is that it is a dome regularly constructed —rough on the outside certainly, but better on the inside—built on modern lines, and it carries back the history of the dome to this remote date. We therefore find that in the fourth millennium B.C., in the Euphrates Valley, every basic form of modern architecture was freely employed. And it was not forgotten; it was not invented simply to die out and be re-invented at a later time. The buildings are generally so far destroyed that the questions of roofing and so on are hard to solve, but we do find examples of arch, dome, and so on, at later dates, proving that the principles never dropped out of use but were handed down from one generation to another.

We found the doorway of a house of about 1930 B.C., much later than our cemetery, where the bricks fallen in the doorway preserved still the form of the arch which they originally composed: the joints are radial, thicker at the top than at the bottom, and with pieces of pottery put between the bricks to preserve that radial form. We were therefore able to reconstruct a house of the period of Abraham, showing the doors arched even in domestic architecture. We have found standing arches preserved from about 1400 B.C., and they were familiar in the time of Nebuchadnezzar in the 7th Century B.C. We have not found domes intact, but we have found plenty of evidence for them. We have found the vault still preserved and fragments of a dome still preserved in the 23rd Century B.C. We have no hesitation in saying that the arch, the vault, the apse, and the dome, used in Europe for the first time in the Roman period, are a direct inheritance from the Sumerian peoples of the fourth millennium B.C. at latest, and they may well go back to a date still more remote.

THE civilization of which I am speaking is, of course, an extraordinarily striking one, and it will be generally agreed that it is no new thing. The people who made those remarkable treasures of gold, mosaic, engraving, and so on, were not tyros. They must have had behind them long traditions, long apprenticeship, and the question arises: Where did they learn these things? Are we to regard this remarkable and finished civilization flourishing in Mesopotamia in the latter half of the fourth millennium B.C. as an isolated phenomenon? Are we to connect it with some other country or does it belong where we find it? In other words, was it brought in from outside by some wave of conquest or immigration, only to disappear, or was it so brought in ultimately to leave its stamp upon future ages? Or did it develop in the country where we find it? Is it really indigenous to the Mesopotamian soil? That it had its influence on succeeding generations nobody can possibly doubt, but the question of its origin is a very difficult one. The first thing to do is to dig in the field, not to form theories but to look in the lower levels of the soil to discover earlier phases of culture there and to see whether there was the thread of continuity or whether there was such a breach or such a succession of breaches as would imply an influx of an alien people, bringing in this civilization from some exterior and to us hitherto unknown place of origin.

For our purpose we selected a spot within the walls of Ur where wind and weather had denuded the surface, destroying all the later monuments of times such as those of Nebuchadnezzar, Abraham, and so on, and laying bare a ground level which was virtually the ground level of 3200 B.C. We could date it tolerably well by excavation that had been done in the neighbourhood, where walls which we could assign to a definite period ran out to the surface and disappeared before they came into this denuded area. We felt that if we dug there, starting with 3200 B.C., digging down into soil where every spadeful of earth taken out would not only bring us deeper in point of place but take us earlier in point of time, we should soon outstrip the age of our cemetery, about 3500 B.C. maximum, and work back to something earlier than that, and so judge, with a fair ground of comparison, the earlier periods which preceded the cemetery treasure.

Starting at that point, we dug down ultimately to over 60 feet. It was not simply a matter of shifting earth; all the way down antiquities were encountered in a regular stratification, as clear as that of geology. Very deep down in the pit we found a wall built of large bricks made of concrete. We found, to our surprise, that concrete went back to the beginning of the fourth millennium and possibly into the fifth millennium B.C. At every stage we were discovering and passing through archeological strata. As soon as we began to dig we encountered walls which were built of mud brick and had perfectly good floors of beaten clay freely littered with the pottery which the last inhabitants left upon them. Often the bricks are laid in herringbone fashion, which was characteristic of this particular period, and the walls vary in thickness from five to 12 feet, so that they are the walls of

Excavating at Ur. Readers often ask why ancient cities are found in layers. The houses were made mainly of sun-dried bricks, which frequently fell apart. Then the fragments would be leveled off and new houses built on top, with bricks brought in from outside the city. Centuries of this cumulation elevated the site

Plan of a royal grave, showing the tomb and the death pit, the team of oxen, chariots, copper helmets of the guards, and other details

buildings intended to last for quite a long time. One can imagine that in most cases they did last for quite a long time, so that to such a stratum as this one must assign a reasonable longevity.

YOU can take a photograph and then destroy the walls and dig through the floors, and immediately there come to light new walls of fresh buildings and a new set of clay floors, marking an earlier period quite unmistakeably. You destroy those in turn and a third wall appears. By the time we had gone something like 20 feet we had discovered, starting at 3200 B.C. at the top, no less than eight superimposed cities, to each of which must be given a reasonable life. Of those eight cities, the topmost three belong to the period of our cemetery. We could tell that by the pottery found, which was absolutely consistent with the pottery found in the graves. With the fourth level there was a change, though not a very marked change. At the fifth level we found lying about the floor pottery of a different type from that found in the graves in the cemetery; clearly we had got to a definitely earlier period. At the sixth level there was another change, and there came to light freely the polychrome painted pottery which is known by the name of Jemdet Nasr, after the site where it was first found, some 200 miles to the north.

With that pottery there appears to come a definite break, because nothing like it is found in the cemetery at all. As pottery is one of our best criteria, it seemed at first advisable to say: "Here is just that breach in history which implies a foreign source for the civilization that succeeded Jemdet Nasr." It was not the only break. We dug through 16 feet of solid pottery fragments; there was practically no earth at all, but merely potsherds. Buried amongst the potsherds at different levels there were the kilns in which the pots had been made. We had discovered a potter's factory that had been worked for an enormous length of time: all these potsherds were merely the fragments of waste pots that came out of the kiln distorted or cracked and had no commercial value, so were broken up and the pieces thrown on to the ground. The makers went on throwing them down until the kiln was buried and they had to build a fresh one, then that became buried and another one had to be built, and so the process went on until there were 16 feet of pottery measured vertically, and the kilns were reduplicated repeatedly one above the other. That factory must have gone on for many generations.

INCIDENTALLY, I might say that during the life of the factory there occurred a most extraordinarily important event. In all the upper levels all the pottery was made upon the potter's wheel exactly as it is made to-day. Then suddenly there came a change, and in the bottom 18 inches or so all the pottery was made by hand and the wheel was not known. In other words, early in the life of that long-lived factory men invented the wheel, or introduced it, and so passed in a moment from the age of pure handicraft to the age of machinery in which we are now living.

Then the pottery began to change. It was quite different from the Jemdet Nasr pottery, which is polychrome and made on the wheel. We were dealing with a simpler hand-made stuff with a certain amount of painted decoration. We worked down through it and suddenly came upon a mass, 11 feet thick, of water-laid sand and clay, perfectly uniform and clean, which was undoubtedly the silt thrown up by the flood—we can actually connect it with the flood which we call Noah's flood—against the flank of the mound on which stood the earliest and most primitive city of Ur. We dug through the 11 feet of flood deposit and underneath it we found the remains of antediluvian houses. Some were built of regularly moulded bricks and others were huts of reeds thickly plastered with clay. Digging through that again, we found that the lowest human buildings rested upon a thick bed of black organic soil, formed by the decay of vegetable matter, and that in turn went down below sea level to a bed of heavy green clay pierced with fibrous brown marks of the roots of plants. That was the bottom of Mesopotamia! It was really the bed of the marsh which spread over all this area before the waters were gathered together into one place and the dry land appeared. It ante-dated the advent of man into the lower valley of the Euphrates, because at that time there was no valley at all. We have gone back in our excavations to a time before human occupation of this particular part of the world's surface began, not to a time early in the history of man—it is all late in the history of man—but to the beginnings of history in the Euphrates Valley.

(To be concluded)

Cups and bowls found at Ur. Some of them are relieved by fluting and by engraved patterns and the conscientious makers even engraved their bottoms

What Is Whiskey?

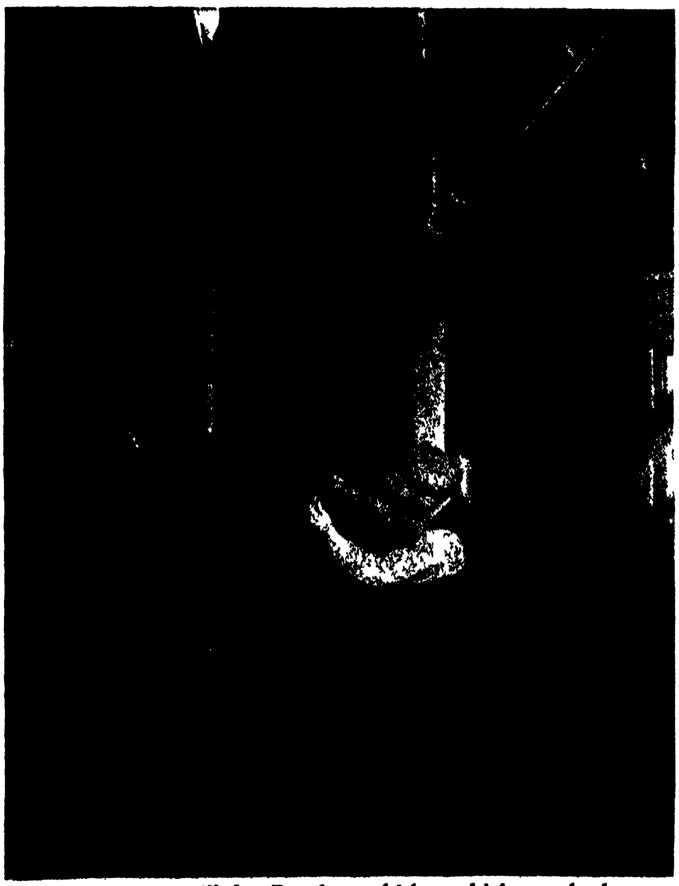
Down Through the Centuries, the Literature of Whiskey has been Scant; Here are Told Some of the Secrets of Real Whiskey

By EARL SPARLING

WHISKEY has been described often by poets and literary men, seldom by scientists. In all ages men have seemed to feel that this usquebaugh, this Celtic "elixir of life," the "most male of all beverages," deserved beautiful words rather than exact ones. So that there is probably no other article of common use about which the average man knows less, and in the manufacture and sale of which, as a natural result, there has been more shady dealing.

FROM as far back as 1577 come these quaintly glowing words set down in Holinshed's Chronicles: "Being moderalle taken it sloweth age, it strengtheneth youth, it helpeth digestion, it cutteth flegme, it lighteneth the mind. it quickeneth the spirits, it cureth hydropsie . . . it pounceth the stone, it expelleth gravell, it puffeth awaie all ventositie . . . it keepeth the weasan from stifling, the stomach from wambling, the heart from swelling, the bellie from wirtching, the guts from numbling, the hands from shivering and the sinewes from shrinking, the veines from srumpling, the bones from aking and the marrow from soaking." (In this modern age, no one would take these words seriously, written as they are with obvious poetic license.)

There are books on wine, a little library of them, and there are books on beer; literally, there is not one book in any language devoted to a technical study of whiskey. I have before me a weighty scientific German tome on distilled spirits; it devoted exactly a page and a half to American whiskies. Here on the desk also is probably the only book ever written on whiskey as such, but it is a wise and witty little volume, poetical, not scientific; Aeneas Macdonald, its author, titles it "Whiskey" and, after extolling Scotch whiskey and neglecting at all to mention Irish whiskey, he goes on to say that he understands Americans drink concoctions made from rye and corn which they ignorantly call whiskey. There is little



A continuous still for Bourbon whiskey which can be kept running even while being recharged with new grain mash

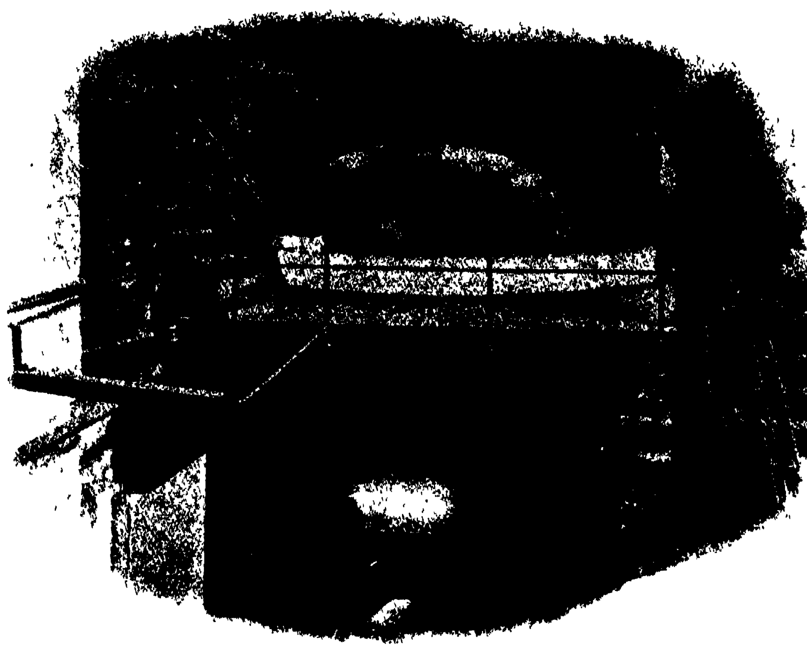
wonder that it took Dr. Harvey W. Wiley two hours in 1907 to prove to President Theodore Roosevelt that plain alcohol was different from whiskey, and that a mixture of alcohol and whiskey was not whiskey, but adulterated whiskey—nor any wonder that three Cabinet Secretaries eventually ruled in 1910 that plain grain alcohol, artificially colored and flavored, was as much entitled to the name "whiskey" as real whiskey aged four years in the barrel.

To become technical: Whiskey is a product distilled from a fermented grain mash, and its distinctive taste and aroma come from the congeners, or so-called impurities (including total acid, esters, higher alcohols, aldehydes, and furfural) which pass over from the mash into the still. Alcohol, on the other hand, is exactly what the name denotes, plain C_2H_5OH, minus as many of the whiskey congeners as modern distillation can remove. Whiskey needs years of ageing before the raw congeners are transformed into the aromatic and agreeable substances which are the only differentiation between whiskey and plain alcohol. Whiskey contains plain alcohol plus these aged and transformed congeners. Incidentally, no chemist has ever been able to state exactly what changes take place in the congeners.

To destroy another popular myth, fusel oil (composed of the higher alcohols) forms an important part of whiskey distilled in any traditional manner, and when properly transformed by age, is a necessary part of true whiskey. Anyone who says that fusel oil should be removed from whiskey is talking not about whiskey but about some product of modern distillation which is neither whiskey nor plain alcohol, nor anything else worth drinking for that matter.

If you had a jug of fermented grain mash and a kettle on the stove you would certainly know what to do to make a distilled alcoholic beverage. You would put the mash in the pot and start boiling it, condensing the vapors in some sort of a receptacle. The first time you boiled the mash your recep-

tacle would contain chiefly water (because, with such primitive equipment you could not control temperature), some alcohol (5 to 15 percent by volume, perhaps) and some flavoring congeners from the grain. To get more alcohol in the final mixture, you would re-boil the distilled mixture in your receptacle (cook is the old word, revived by American bootleggers who spoke of re-cooking denatured alcohol). With such primitive equipment you would have to re-cook your distillation several times to get as much as 20 to 30 percent of alcohol by volume—or 40 to 60 percent American proof. No matter how many times you re-cooked it there would still be congeners present, for the higher alcohols pass over even before plain ethyl alcohol which, of course, makes up the largest percentage of the whiskey's alcoholic content.



A typical modern pot still, in which only whiskey with a large quantity of congeners can be produced. The final product of this still requires long ageing

THE Irish, who are credited with the discovery of whiskey, to this day call their illicit moonshine liquor "poteen," which is proof enough as to how whiskey was made in ancient times. Out of that past came the method known as "pot still," which duplicates, on a commercial scale, the exact processes by which the original Irish usquebaugh was distilled. In preserving for posterity this ancient and honorable way to produce whiskey the Irish get all the credit. John Jameson & Son, Ltd., one of the oldest distillers of Irish whiskey, have distilled and sold unadulterated pot-still self whiskey for 134 years. Today it is available throughout the civilized world.

The pot-still method is the most costly commercial distillation process. It is relatively costly because in the first place the charge of mash must be put in and run, and the exhausted charge must be washed out before a new charge can be entered. No matter how the operation is speeded up with secondary stills and even when stills having a capacity of 15,000 and 25,000 gallons are operated, this old fashioned distilling method is a slow and costly business. Further, it is costly to pot-still whiskey in that the pot-still method allows the congeners to pass over in such volume that the whiskey must be stored and aged for at least seven years. Taking all factors into consideration, it costs approximately five times as much to produce a pot-still whiskey as to produce the same quantity of patent-still spirit.

The whole drive of modern distillation has been to reduce the amount of congeners passing over and to increase the amount of plain alcohol. The purpose has been to produce a whiskey which would be high proof in fewer operations and one which, because of fewer flavoring congeners, would require less ageing.

About 1830 the Coffey still was introduced in Scotland. The Coffey, or patent still, inaugurated continuous distillation. In between the old-fashioned pot still, even as modified, and the form of continuous distillation now chiefly used to produce cheap whiskies, stands the charged chamber still, usually of three or four chambers. In effect, the charged chamber still is one which benefits from part fractional distillation but still retains some of the benefits of the pot on the stove. In the chamber still a charge of mash is placed in the top chamber where it gets the least heat. After a period of distillation it is dropped by lever to the second lowest chamber, where additional distillation goes on, thence to the third chamber, and the fourth. As soon as the first chamber is empty a new charge of mash is entered. All the great American whiskies, whether Bourbon or rye, were produced by this fractional modification of pot distillation. But the chamber still is apparently passing out now; post-repeal American distillers have found the continuous still, descendant of the Coffey still, more profitable.

The continuous still is a tall, many-chambered column. The fermented mash goes in at the top, falls by gravity through as many as 20 to 30 chambers, and comes out denuded of all available alcohol. Usually the last steps of the process are accomplished in a doubler or analyzer column. The distiller is able at all times to regulate the amount of congeners passing over. A continuous still can be adjusted, by pressure, heat, and so on, to produce anything from a heavy whiskey which will require years of ageing to a nearly neutral spirit which will need very little ageing. The quality of the whiskey so produced depends on how the still is operated, on what proof the whiskey is distilled at, and the quantity of congeners allowed to pass over—and, of course, on the kind and quality of the grains that are used.

IT is evident that a truly neutral alcohol must come off at about 190 to 198 proof and must be virtually free of all the impurities which distinguish whiskey. Where does whiskey cease to be whiskey and become neutral alcohol? The American law has put the dividing line at 160 degrees of proof. If the spirit issuing from the last distilling operation is under 160 degrees of proof (80 percent of alcohol by volume) it is legally whiskey.

Many distillers, naturally, keep their continuous stills going under a pressure and heat which will produce a whiskey as near to this proof as possible and which will yet contain enough quickly maturing congeners to give the final product a whiskey color and taste. The point is that the pot still can seldom be pushed above 140 degrees. In many cases 130 degrees of proof seems to be the practical limit, which is also the practical chamber still maximum. Because such a whiskey is pulled off at such a low proof, it contains more congeners and is more truly a whiskey in the traditional sense.

The issue might be stated this way: the higher the proof at which the distiller takes off his whiskey for ageing, the fewer congeners it will contain but the more 90 or 100 proof bottled stuff it will make. The lower the proof at which he takes it off, the less whiskey he will have to sell, but the more connoisseurs will hunt for it.

MYSTERIES OF THE SOLAR CORONA

By HENRY NORRIS RUSSELL, Ph. D.

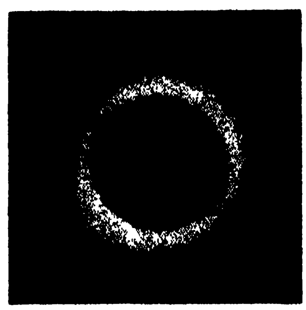
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. Retiring President of the American Association for the Advancement of Science

TWENTY years ago a long list of "unknown" spectral lines tempted the astrophysicist with the prospect of new worlds to conquer. Bit by bit that conquest has been made.

First of all, a generation ago, helium, previously known only by its production of bright lines in the spectrum of the sun's atmosphere and corresponding dark lines in the hottest stars, was run to earth and became one of the most valuable materials of physical research. More recently the puzzling lines which shone so brilliantly in the spectra of the gaseous nebulae were shown to be emitted by atoms of the most familiar kinds, oxygen, nitrogen, and sulfur, under conditions which could be realized only in incredibly rarefied gases where these atoms were left undisturbed by collisions with others. At about the same time the strong green line in the spectrum of the aurora was found to be a similar forbidden line due to neutral oxygen atoms in the thin upper portion of the earth's atmosphere. The numerous bands which appear also, though less brilliantly, in the auroral spectrum were recognized as due to molecules of nitrogen.

ONLY today comes in a report from Dr. Kaplan that in a new type of nitrogen vacuum tube, and especially in the after-glow which follows for a moment the cessation of the discharge, he has found a number of bands, demonstrably due to nitrogen molecules, and identical with previously unknown auroral radiations. Another large group of unknown lines which appeared only in the very hottest stars have been almost completely identified, as a result of recent work with the vacuum spectrograph, especially the admirable researches of Edlén at Upsala, and found to arise from light atoms, carbon, oxygen, and nitrogen, in very high states of ionization. Many of the bright bands which characterize the spectrum of temporary stars as their light begins to fade are now known to be of similar origin, and the work of a few more years bids fair to clear up the rest.

Another, and quite different, field of ignorance was represented by the wide and conspicuous dark bands in the spectra of the greater planets. The work of Wildt, confirmed by the high dispersion observations of Dunham, showed that certain of these were undoubtedly due to ammonia in the planets' atmospheres, and others to methane. A month ago, at the Washington meeting of the National Academy of Sciences, a telegram from the Lowell Observatory announced that, in co-operation with theoretical workers at the University of Michigan, most of the other strong bands which appear in the outer planets are likewise to be attributed to methane. So that it appears that their atmospheres are very largely composed of



A photograph of the solar corona taken at the eclipse of August 1932, by John M. Pierce, amateur

what we in everyday parlance call "natural gas."

One astrophysical spectrum, and only one, still remains mysterious—the bright lines of the solar corona. Accordant observations during many total eclipses, supplemented by the remarkable work of Lyot outside of eclipse, have given us good wavelengths for many of these lines, and shown that they are permanent features of the spectrum, though possibly with moderate variations in intensity from one eclipse to another. Yet we still know practically nothing of their origin. Reasonable suggestions, based on the modern theory of spectra, have recently been made that some arise from neutral, and others from ionized, atoms of oxygen and nitrogen. But it is not yet practicable to predict accurately where these lines ought to lie in the spectrum, and until this can be done the matter must remain undecided, unless, of course, some fortunate observer succeeds in reproducing some, at least, of the coronal lines in the laboratory. One red line, indeed, at 6374, coincides very closely with a laboratory line of oxygen, but the investigations of Frerichs show that this is closely related to other oxygen lines which do not appear at all in the corona, so that this must be an accidental coincidence.

These problematical radiations, however, form but a very small part of the total light of the corona. Recent measures by Grotrian, of photographs taken by a German expedition to the Sumatra eclipse of 1929, show that the green line, which is far the brightest of all, gives only one percent of the visible light. The other 99 percent shows a continuous spectrum, and considerable gain has recently been made in its interpretation.

VARIOUS facts which have long been known indicate that the continuous spectrum of the corona is not all of the same origin. For example, the light is polarized as it should be if reflected from very small particles. Close to the sun's limb, the polarization is incomplete, which is easily accounted for, since we get light from regions in front of the sun and behind it, as well as from those of the same distance, and the angles at which the light is scattered are very different in the three cases. But, at greater distances from the sun, the light should be more and more completely polarized, and this is not the case.

Again, the Fraunhofer lines of the ordinary solar spectrum are present, although faint, in the spectrum of the outer corona, while in the inner corona they disappear entirely. These lines must certainly be produced by reflected or scattered sunlight. Their faintness in the outer, and absence in the inner, corona suggests that they are diluted, or drowned out by light from some other source giving a continuous spectrum. It was once supposed that this continuous spectrum came from small incandescent particles heated by the sun's

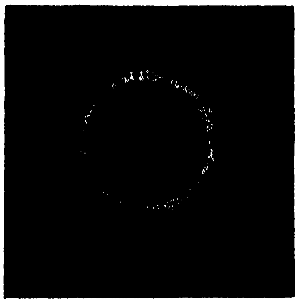
radiation. These particles would obviously not be as hot as the sun itself, and hence they would emit light of a redder color. Photographic observations, however, show that the coronal light is of very nearly the same color as that of the sun itself, thereby eliminating one more promising theory. Indeed, this simple fact disposes of two rival theories at once. It has often been suggested that the coronal light is scattered by a very thin gaseous envelope surrounding the sun. But light scattered by molecules or atoms of gas would be bluer than sunlight and of very much the same color as that of a clear sky. Here again the observations are decisive. The corona is neither red nor blue, but white (taking sunlight as our standard).

THIS narrows down very considerably the search for the sources whence it comes, but leaves two still available. A cloud of solid or liquid particles, larger than two or three wavelengths of light, will reflect all colors equally, and will, indeed, be as white as any ordinary cloud. At the other extreme of minuteness, a cloud of electrons will act in the same fashion, and scatter light waves of any length in the same proportion; so that an electron cloud again seen at a distance would appear as a white cloud. Nothing of the sort has ever been seen on earth. Fortunately for its inhabitants, clouds of intensely electrified material do not occur upon our planet. But we know that in the upper portions of the sun's visible atmosphere, ionization is very high and great numbers of free electrons must be present. Above the visible limit of the chromosphere and prominences there may well be great numbers of free electrons. A cloud of electrons, and a cloud of fine drops or dust particles, would reflect light of just the same color, and, with proper adjustment of their thickness, of the same brightness. What hope is there then of distinguishing between the two?

Fortunately for our study, there is one important difference. Electrons above the sun's surface are certain to be moving in all directions at very high speeds. In a hot gas the particles are moving rapidly, and the lighter they are the greater is their average velocity. At the temperature of the photosphere, the average speed of a hydrogen atom would be not far from 10 kilometers per second. Electrons with only 1/1840 of the mass would have a thermal velocity averaging 400 kilometers per second.

An electron at rest, or a great cloud of them, would scatter sunlight just as it fell upon them, and the scattered beam would show the ordinary solar spectrum, dark lines and all. But, in the light scattered from a moving electron, the lines would be shifted by the Doppler effect in the ordinary fashion. The motions just described are so rapid that they would smear out any ordinary lines completely and leave a practically continuous spectrum. The very widest solar lines, such as the great H and K lines in the violet, might still show faintly, and Grotrian has found that they actually appear feebly.

The truly continuous part of the coronal spectrum may therefore be attributed with some confidence to scattering of light by free electrons, but this does not settle positively the origin of the other part of the light, which shows the dark lines. If other electrons, with slow motions, were present, they could produce this spectrum, and so, too, could light reflected from true clouds of vastly larger particles. Grotrian has made careful measures of the width of the dark lines in the coronal spectrum obtained in Sumatra, and also in the ordinary solar spectrum taken with the same apparatus. The measures show that in the corona the dark lines are shallower than in the solar spectrum, but not wider. The "shallowness" is obviously due to dilution of the spectrum with the continuum scattered by the free electron. Could this be removed, the lines would be found as narrow as ever. This shows that the scattering particles must be very much heavier than electrons. Even in the outer parts of the corona the temperature must be as high as 2500 degrees, absolute, and the motion of the electrons would be rapid enough to smear out completely any narrow dark lines in the light which they scatter. Isolated atoms would not be moving too fast, but they, as has been said before, would scatter blue light more strongly than red. Grotrian therefore concludes that the Fraunhofer spectrum of the corona is scattered by relatively large particles. These need not necessarily be solid, but might be tiny drops of liquid.


The sun's corona, photographed at the August 1932 eclipse, by Leo J. Scanlon, a Pittsburgh amateur

One difficulty remains. At the temperature even of the outer corona, almost all known substances would be completely volatilized, especially in an almost perfect vacuum There are some compounds, however, such as the carbides and nitrides of titanium, tantalum, and some other metals, which are exceedingly refractory, and melt only at temperatures approaching 4000 degrees. To what extent these substances would volatilize if held at 3000 degrees in a vacuum has not yet been determined. But it is not at all impossible that minute drops of these refractory materials may actually be formed by condensation in the outer corona, and remain there, held up by radiation pressure against the sun's attraction.

The microphotometric measures show that the depth of the faint Fraunhofer lines increases steadily with increasing distance from the sun. From this Grotrian concludes that at a distance from the moon's limb equal to one-third the moon's radius, more than 80 percent of the coronal light belongs to the continuous spectrum, and less than 20 percent to the "Fraunhofer" spectrum. At a distance equal to the moon's (or the sun's) apparent radius, the two contribute about equally. At the outer observable limit, 26′ from the moon's edge, only one-third of the light belongs to the continuous portion.

THE electron cloud around the sun therefore thins out much more rapidly than the cloud of larger particles. To the former Grotrian attributes the irregularities of the coronal form, including the arches and streamers which are such beautiful features of the photographs. The dust cloud appears to be much more uniform, and probably thins out gradually into the zodiacal light. Even at the longest eclipses, the corona can be seen only through a foreground of air illuminated by sunlight reflected from regions less than 100 miles away, where the direct rays still reach the earth. The corona dies out into this general sky illumination, while it is still very bright in comparison with the night sky, and something like 10,000 times as bright (for equal apparent areas) as the very feeble glow of the zodiacal light. The transition between the two is unfortunately inaccessible to terrestrial observation. The zodiacal light cannot be followed nearer than 30 degrees from the sun, since the twilight interferes. If the moon was only half as big again as it is, we might get eclipses in which all the bright inner corona was hidden, and the shadow spot on earth was so large that practically no scattered sunlight reached the center. But, with the moon as it is, even the best eclipses are not dark enough to reveal how the coronal light really fades out.

It is lucky for terrestrial astronomers that the moon is no farther off. Six percent increase in its distance would deprive us altogether of total eclipse, and of all knowledge of the corona.—*Princeton University Observatory, May 28, 1934.*

RATTLERS AND THEIR

By WILL C. BARNES

One time Secretary of the National Geographic Board, and assistant forester in charge of range management, United States Forest Service

TO any lover of outdoor life the question of snakes is a matter of vital moment. Forest officers, cowboys, sheep herders, and others constantly out in the open become accustomed to the thought that reptiles are part and parcel of their daily life and accept the hazard without much concern.

With the exception of two or three varieties, American snakes are harmless and quite as interesting in their ways as any of the wild things of woods or plains. First and foremost among poisonous snakes is, of course, the rattler. He is followed by the moccasin, the copperhead, and the coral snake. But their habitat covers a comparatively limited area of the United States, and deaths from their bite are few.

THE rattler, however, is found from the Gulf of Mexico to the Canadian boundary and from the Atlantic to the Pacific. Only in Maine and New Hampshire is he reported as being absent. He seems quite as much at home in Montana as in Florida, and he enjoys the desert of southern Arizona as much as the humid regions of the Atlantic coast. You will find him below sea level in the Death Valley country of California, and again close to timberline all over the Rockies.

According to Ditmars, there are 13 known species of rattlers in this country, ten of which are found in Arizona. Texas has four varieties. Don't get the idea, however, that the Southwest is headquarters for rattlesnakes. Authorities agree that as far as can be determined the center of rattlesnake population is in Pennsylvania, Massachusetts, New York, and New Jersey.

Many people, unaccustomed to camping out, consider it absolutely necessary to provide for protection against attacks of these reptiles which really mean them no harm and would gladly be friends if given the opportunity to show their true nature. The most they ask is to be let alone and allowed to go their way in peace. Sometimes, of course, it is otherwise.

Once an insurance agent tackled a Texas cowboy to take out an accident policy, stressing the uncertainty of life.

"You have all sorts of accidents, don't you?" queried the agent.

"Nope, nothin' ever happens to me," was the reply.

"No injuries? No hurts of any kind?" The agent was out for business.

"Well," said the boy, searching his memory for some incident, "there was a rattler bit me once."

"Wasn't that an accident?" commented the man.

"Hell, no!" said the Texan, "the danged snake did it a-purpose."

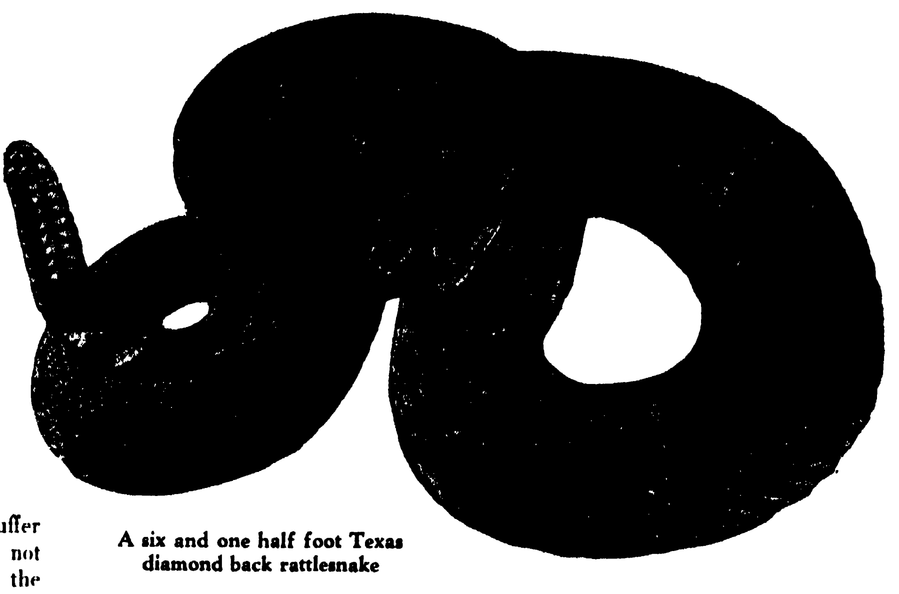
But unfortunately the snake family has a past and is paying the penalty for the single unfortunate act of one of its forebears. It was the Serpent that got our original parents into trouble and sent them in disgrace out of the Garden of Eden. Ergo, every one takes it out on snakes whether it be the pretty and absolutely harmless garter snake or the huge surly, quick tempered, diamond-backed rattler of the Florida swamps. The rattler, however, is a fair fighter for he always gives warning of his proposed attack, generally to his own undoing.

Guaranteed not to bite. This rattlesnake is only a model made for exhibition at the Field Museum of Natural History, to illustrate how the snake secretes and discharges its poison. It is being shown by Leon L. Walters, creator of the model

MORE than 40,000,000 people visited the National Forests and National Parks last year, the majority of whom camped out and tramped over the country fishing, picking wild flowers, taking pictures and exploring every available nook and corner. Yet the number attacked by these reptiles is practically negligible while the fatalities can probably be counted on the fingers of one hand. Unfortunately, there are no records of such accidents on our public playgrounds. They should be kept, just to reassure people that the risk is very low. Nevertheless, people like to be prepared for such an emergency, for it is the unexpected that always happens. The person bitten by a rattler cares little for statistics or percentages of deaths. To him, his case is a national matter. He wants help and wants it quickly.

Up to a few years ago there was but one known remedy for the bite of a rattler. That was alcohol. Whiskey, being largely composed of alcohol, offered the most available remedy. The effect

BITES*



A six and one half foot Texas diamond back rattlesnake

of the venom from a rattler is to coagulate the blood and slacken its circulation. If it does not get into the venous system no harm results. This is why hogs are never killed by rattlers. Their venous system is protected by a thick layer of fat through which the poison does not penetrate. This is also the reason why many people struck by a rattler do not die or suffer serious harm—the venom does not reach a vein. It also accounts for the fact that the poison may be sucked from a bite and even swallowed without harm, providing, always, that the person doing the sucking has no cuts or sores on lips or mouth.

When planning outings years ago, plenty of whiskey was provided. If not needed for snake bites it afforded an attractive addition to the supplies for the trip. Then scientists discovered that the action of whiskey in stimulating the circulation was about the worst thing that could happen. The poison was the more rapidly carried into the venous system and its distribution made more effective.

So whiskey as an antidote for rattlesnake bites was declared taboo and went into the discard, except among a lot of old-fashioned people who always cling to their early training. About that time some chemist started the idea of using permanganate of potassium as an antidote for snake poison. This has been the approved remedy for the past 20 years. Kits for its use were sold everywhere and thousands of people are today carrying them, firm in the belief that they are an insurance against death from rattlers. Most forest officers and park rangers are provided with these kits. They contain two little glass bottles in a wooden case, together with a very small hypodermic. In one bottle is alcohol, in the other the crystals of potassium. Pour one into the other and you have a solution which when injected into the flesh at the wound does the business. I have seen it accomplished by simply pulverizing the crystals in a teaspoon, and after slashing the flesh around the bite, rubbing it into the wound.

But here in the last year or two come scientists who tell us we are all wrong; that permanganate is useless as a protection and positively injurious to the patient. Briefly, the claim is made that the action of the permanganate is to cause a sloughing away of the flesh around the spot where injected, forming serious sores that cause the patient untold suffering. The remedy seems worse than the disease. It is admitted, however, "that in the absence of other remedies permanganate may be used." Evidently a case of any port in a storm.

Pulling back the sheath which protects the hollow fang of a snake

In December, 1927, the Surgeon General of the United States made the following comment in regard to the use of the above material: "A very interesting article on first aid treatment for snake bites will be found in the *Texas State Journal of Medicine* for July, 1927. This article, we believe, pretty well disposes of the contention that permanganate of potassium is of value in the treatment of snake bites although it is realized that it is the orthodox thing to apply. It is believed that it would be of distinctly more value to make incisions at the site of the wound made by the bite of the serpent and to apply suction either mechanically or by the mouth."

Science, however, never stands still. Other countries were suffering severe losses from venomous snakes. Study of the situation was begun, seeking a real remedy.

The latest and most successful method of counteracting the effects of snake venom is through the use of what is known as "Antivenin," or anti-snake-bite serum, a concentrated serum derived from immunized horses which have been gradually dosed with rattlesnake venom. This antivenin is the result of years of study and investigation seeking a satisfactory cure. It was carried on in Brazil by officials of that country who have made most detailed studies of this matter. It is now issued and sold in the United States under license from the United States Public Health Service. It comes in small convenient packets with syringe and full instructions, ready for instant use. Presumably it can be obtained at any large drug store.

THE results of hundreds of experiments on both humans and animals carried out under the direction of the Antivenin Institute of America, an organization devoted to developing means of preventing deaths from venomous reptiles, seem to prove conclusively the value of this latest method.

Concerning this new remedy the statement of the Surgeon General above quoted says: "In regard to antivenin, there is experimental evidence that it is of value—just how much value under

*Courtesy *American Forests*, magazine of the American Forestry Association, 1713 K Street, N.W., Washington, D. C

A Texas diamond back rattlesnake. In the East, rattlesnakes are traditionally plentiful in the West. In the West the same kind of tradition relates to the East. Wherever you travel, the worst pests are always somewhere else but "not here"

clinical conditions one could not say."

By mechanical suction is meant the use of small affairs called breast pumps which are readily secured at any drug store and doubtless make a better job of the withdrawal of the venom than the mouth, without the possible danger to the person whose mouth is being used.

And so permanganate of potassium follows whiskey into the closed files and its place is taken by this new serum.

"These here now scientists," writes an old time cowboy friend, "they make me tired. First they took away our excuse for carryin' round a flask of whiskey and told us to bank heavy on permanganate of potassium. An' now when we are all broke to regardin' that stuff as the onliest thing ever for snake bite, along comes a new outfit an' tells us there's nothin' to it, an' that this here now old horse serum is the only sure fire stuff. Even you had to horn in on the thing and spoil the old time hair rope idea. Ain't there nothin' sacred to you fellers any more?"

NOW, of course, comes the natural question—what to do if bitten by a venomous snake.

First, of all times in your life, keep your head. Don't get excited. That only makes your blood circulate the faster and carries the venom into your system the quicker. Next, be sure you have been bitten. A snake may strike at one viciously but fail to reach his mark. If that part of the body believed to have been struck is covered with the usual clothing the chances are good that no harm has been done. Inspect carefully, however, the spot where you think the reptile struck you. The fangs are very short and sharp. If they have penetrated the flesh you will find a drop or two of blood oozing from the wound. Severe pains are felt within a very few moments after an effective strike.

The spot swells rapidly. There will be symptoms of nausea. The pulse is rapid.

If convinced you have been struck, get a doctor if possible. He will know best what to do. But if no doctor is available apply a tourniquet above the bite to keep the poison from entering the venous system. Anything will do—a rope, a shoe string, a handkerchief, or a necktie. Twist it with a lead pencil or piece of wood. About every ten minutes loosen the tourniquet for three or four seconds, then tighten. To keep it closed longer is not only painful but may bring about gangrene. Slash the wound a third of an inch deep, and an inch long. An ordinary safety razor blade is excellent and always available. Dip it first into boiling water or hold it over a flame to sterilize it. Make sure there is not a loose fang in the wound. They are often left by the snake. The excessive bleeding caused by the slashing washes the venom from the wound.

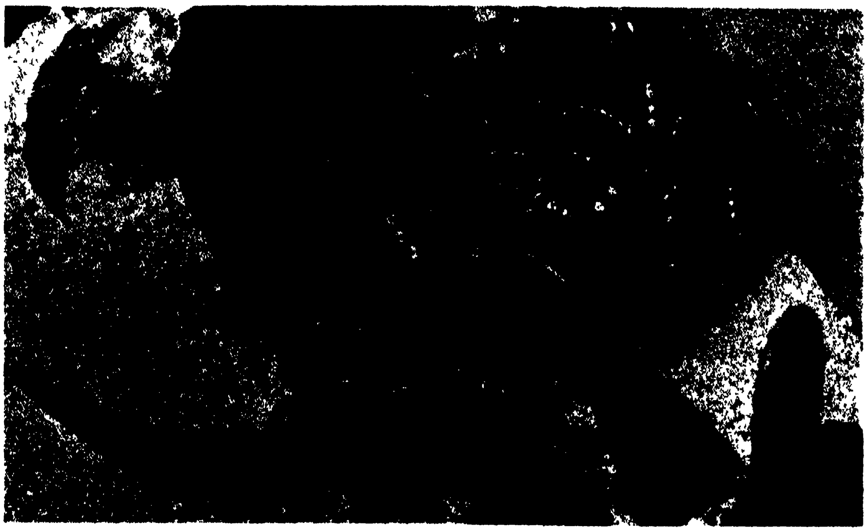
If the mouth is sound, no sore lips or gums, you, or a friend, can safely suck the wound to help eliminate the venom. If an ordinary breast pump is handy, use it.

If the antivenin serum is not available keep the wound wet with a 1:3000 solution of permanganate of potassium. Inject it hypodermically around the wound or rub the powdered crystals into it. If the heart is greatly depressed stimulate it with one thirtieth of a grain of strychnine or one one-hundredth of a grain of nitroglycerine. Lacking these, a teaspoonful of aromatic spirits of ammonia in a warm glass of water at about an hour interval will help. A cup of strong coffee will get heart action also.

POTASSIUM is, of course, to be used only when the serum cannot be had. It is used more to encourage the patient and build up his spirits and morale rather than because of its curative values. If the serum can be obtained use as directed even though from 12 to 24 hours have elapsed.

The tourniquet may be abandoned after a couple of hours or even sooner if the pain from it seems to be too severe. If the bite is on the face or where a tourniquet cannot be applied you must depend on the slashing of the wound and sucking the poison from it. As a matter of fact, all authorities agree that this process of getting rid of the poison is about 75 percent effective in nearly all cases. Above all, use no whiskey. Every investigator advises that persons who have been dosed with whiskey, and recovered, did so "not because of it, but in spite of it."

Don't get conceited and believe you can handle a rattlesnake without harm because the Hopi Indians in Arizona do so. They and their forbears have been handling rattlers for thousands of years. Coronada's men found them doing it as early as 1540.



Another Texas diamond back rattler, camouflaged by cactus and other vegetation. Rattlers almost always give warning but humans often court danger

SCIENCE REPLIES TO SECRETARY WALLACE'S ARTICLE:

'The SCIENTIST in an UNSCIENTIFIC SOCIETY'

HAS Science really failed in respect to "the greatest good for the greatest number," as Secretary of Agriculture Wallace asserted in his forthright article in our June issue? Should scientists now set aside a fellowship or start a foundation purely for a study of the social significance of its works? We, as the scientific mentor for laymen, should like to know.

In asking Mr. Wallace to write his challenge, we explained to him that, in probing for an answer, we would ask a number of scientists to give us their viewpoints. The accompanying group of comments is the result. Others will follow. At this point, however, we shall not attempt to analyze these statements, but shall simply present them for possible future analysis by other scientists!—
The Editor.

By:

DR. CHAS. B. DAVENPORT
Zoologist, geneticist, Director of the Station for Experimental Evolution, Carnegie Institution of Washington

DR. WILLIS H. WHITNEY
Vice President, General Electric Company, in Charge of Research

EDWIN G. CONKLIN
Professor of Zoology, Princeton University

T. D. A. COCKERELL
Professor of Zoology, University of Colorado

DR. JOHN C. MERRIAM
Geologist, paleontologist, President Carnegie Institution of Washington

CHAS. F. KETTERING
Vice President, General Motors Corporation, General Director of Research Division of General Motors

DR. C. G. ABBOT
Astrophysicist, Secretary of the Smithsonian Institution

DR. DAVENPORT writes:

I HAVE read with interest Mr. Wallace's statement on "The Scientist in an Unscientific Society" and am writing down the thoughts that were aroused in me by reading it. It may, at least, reveal something of the nature of one of the scientific men to which group Secretary Wallace refers.

First, let me say that I am a biologist and that my contacts have been with biologists and other men engaged in pure scientific investigation, and I know very little about technology. Apparently, most of the specific cases of social trouble caused by discovery are really cases of the application by technologists of scientific discoveries. When Hertz discovered that electric waves go through the air, and attempted to measure them, he made it possible for technologists like Marconi and others to lay the foundations of a great industry which has given occupation to thousands of persons. However, if it should appear that broadcasting was being used to incite to crime, murder, bloodshed, and revolution, some might find that it were better had Hertz never been born. Others might think that the trouble was not with Hertz and his discoveries, but with the lack of social control of the application of those studies. Such social control would obviously, however, not be the work of Hertz.

As I say, I am only a biologist interested in discovery of biological laws. From my own standpoint (which I hope will not shock the pious) I think of the biologist as trying to discover the laws of Nature, which are the laws of God. I think the biologist believes that if we understood the workings of God, we would be in a better position to put ourselves in gear with this universe, and this I consider to be the essence of morality. We cannot, however, be fully moral if we do not know something of the laws of the universe. The moral laws of the primitive people who live on the mountains of New Guinea are very definite; only, since they are not based on a knowledge of the workings of the universe, they are apt to be in some cases unjustified. While in general the *mores* of any people are based upon experience of that people in their own habitat, some of them are based upon false interpretation of cause and effect. For example, the drought must be due to an evil spirit and sacrifices must be made to this evil spirit in order to appease him and put an end to the drought.

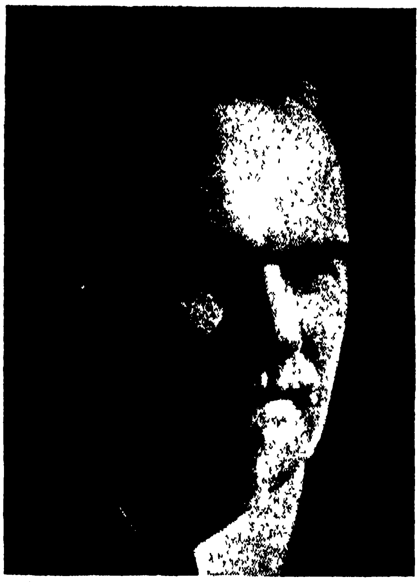
When the biologist learns how the child develops and the rôle that the genes and the cytoplasm of the germ cells play in that development; when he understands the effect upon that development of environmental conditions that are prejudicial to normal development even with the best equipped germ cells; then he is in a better position to state what matings are desirable, what undesirable, what physiological conditions surrounding the developing embryo are good and what are bad. Similarly the biologist may learn, in general, how animals and plants grow and what are the best conditions for development. He learns, too, about the laws of his own nature, and the relations to the bodily functioning of external conditions. This knowledge will place him in a better position to work most effectively, and the general spread of this knowledge will tend to increase the effectiveness and happiness of the population.

One does not see how the discovery of the laws of God in itself is a bad thing for mankind. It is pretty obvious that the trouble lies elsewhere, and "picking on" the scientist is "picking on" the wrong element in the trouble.

I am not only a biologist, but also a citizen and I have thought a little upon the varying economic conditions to which our population is subject. If, leaving science, I may turn attention to some of these contemplations I would set them down as follows:

One trouble with our economic condition is the general tendency of our people (like that of the peoples in other countries during the last two or three thousand years) to seek that which is bad for them; namely, ease, comfort, luxury. Beginning with the wealthy this ideal extends even to the lowest economic strata of society. If, having established ourselves comfortably in the easy chair provided by prosperous times, we suddenly find this easy chair pulled out from under us, we utter an indignant protest and demand that this ease be restored. I have seen among my neighbors many persons engaged in easy occupations who, when these easy occupations were removed as the result of hard times, instead of finding out what sort of occupation was a necessity to their neighbors and engaging in that (which would be sure to bring them some remuneration) did nothing but protest. Others made their way to the bread lines, or to the public relief agencies to get some help. It would be

better if every person with normal mentality had two or more occupations; an easy one for prosperous times and a more difficult, but more necessary, one for less prosperous times. It is one consequence of our love of ease that we demand higher monetary return for our labor. These demands, when put into effect, result in increased cost of production, and this leads to reduction in



" .'picking on' the scientist. . ."
DR. DAVENPORT

consumption; so that the person who is not contented with a reduced income tends to dry up the only source of income available to him.

One source of our economic trouble is not referred to by Secretary Wallace. This may be illustrated by the fact that during the past 20 years the taxes upon my wife's farm have increased 20 times. In fact, the cost of government in the town and county in which I reside have increased about in the same proportion. Now why this enormous increase in the cost of government? It is superficial to attribute it exclusively to the politicians More remotely it goes back to the whole system of welfare workers, of engineers, of technologists, perhaps, who are seeking to make life easier while they make it, at the same time, more expensive. Today, every school must have a policeman attached to it to see that the children are cared for in crossing the street in coming to the school, leaving it at noon and again in the evening. The policeman so assigned can do very little else. The suggestion that somebody else than a policeman might perform the function, even without pay, is indignantly repelled even by those who object to the high taxes. We must have subways and we object to paying for them; we must have bridges, then protest against a toll upon them; we must have concrete roads and parkways, though their building brings the county to the debt limit.

The expenses of government have thus multiplied due to the ever-increasing demands of the people, instigated by the welfare workers, the city planners, the engineers, and the technologists, who, through skilful advertising, create a public demand for their services and products. Where one-quarter of one's income is spent for government there is only a small fraction left over necessities for maintaining even a reasonable standard of living, and in times of reduced personal income without reduction in the cost of government we are, many of us, on the verge of starvation. What is needed is not a greater development of welfare agencies, or the invention of new methods of taxation, but rather the organization of a group of investigators who can show how the cost of government can be reduced, how we can simplify our social activities.

We hear much of the terrible situation to which hard times have brought us. If the view that our troubles are largely due to too much prosperity and love of ease be adopted, it might be concluded that hard times are really good times, that they encourage initiative, they keep people at work on necessities rather than the production of things which are merely contributory to ease. A period of great prosperity is calamitous to the social organization, tends to lead to a drying up of the population through failure of breeding, because, forsooth, the bearing and rearing of children is not comfortable. It interferes with our productiveness because work is hard and is to be avoided as much as possible.

In this final paragraph I would say that, from my standpoint, the discovery of the laws of the universe ought not to be interrupted. But the application of the laws discovered by the scientist to technological affairs is to be regulated. A diversity of training for useful occupations is to be encouraged in the young. A rigorous training in difficult occupations is to be afforded all of the young who are physically capable of such rigid training. Hard work and repression of the love of ease are to be inculcated. The luxury of rest is appreciated only by those who have tired muscles. Effort, fatigue, are our greatest blessings because they enable us to appreciate the better their temporary absence. Finally, extravagance in government under whatever pretext or however high the motive lays a crushing burden upon every civil member of the community and tends toward repudiation or revolution, or both.

From DR. WHITNEY:

IN the case of Secretary Wallace's article, I am unwilling to throw pebbles at new machinery, if I can control myself. I admit that this is a little difficult, because I have long felt that scientists, as they actually exist, have particular value to the public—primarily because of their high differentiation. They usually have to sacrifice their natural instincts by refraining from even such generalizations as political science, in order to make the best use of their specialization. I think that no

". . . pebbles at new machinery . . ."
DR. WHITNEY

group really does more for the public than the specialists in the different sciences.

I have often regretted that I could not do more to help the work of the SCIENTIFIC AMERICAN. I realize all too well that my bump of preoccupation is excessive.

PROFESSOR CONKLIN writes:

I AM deeply interested in Secretary Wallace's challenging article in the June number of SCIENTIFIC AMERICAN, entitled "The Scientist in an Unscientific Society." In general I heartily agree with his criticism of scientists for not taking a larger interest in the problems of citizenship, but on the other hand I recognize that concentration on scientific discovery is not usually compatible with devotion to governmental or political problems. This is due not only to a lack of knowledge regarding such problems, but also to a lack of time and opportunity.

I think the most serious criticism that can be made of a certain type of scientist is that he has become infected with the spirit of commercialism. This applies particularly to those who are engaged in work of great economic importance.

Secretary Wallace does not tell us how scientists can correct the evils which science has made possible in modern society, and I can think of no

way in which this can be done, except by applying the methods of science to the reorganization of society itself. This is no easy or short remedy for present evils, but I believe that it is the only permanent and rational one. We need, in short, a new spirit of co-operation in society, a spirit of altruism such as once characterized the work of such scientists as Faraday, Pasteur, and Agassiz who

© Harris and Ewing

"... things take their course ..."

DR. MERRIAM

"had no time to make money," and who freely gave their discoveries to mankind. Such a return to the spirit of the heroes of science can be brought about only through the process of education. It is the problem with which ethics has always dealt—how to make men live up to the level of their best knowledge and instincts. The problem is really one of making an unscientific society scientific, and if there is any other method than that of education for accomplishing this I have not heard of it.

PROFESSOR COCKERELL:

SO far as I am able to judge, Secretary Wallace has presented a valid argument. It may, however, be useful to continue the discussion from the point where he leaves it. It is a question how far the shortcomings of the scientific man are inevitable, and how far due to scientific and social conventions. The "very best minds—the exact thinkers," as they were described in the editorial note at the top of the Secretary's article, may not always be competent in fields which they have not made their own by prolonged investigations. The scientific habit of thought, so foreign to the politician, should be a great asset in the study of social problems. Yet it always teaches caution, and warns us of the danger of reaching conclusions without adequate researches.

Thus, for the average scientific worker who accepts Secretary Wallace's criticism, the problem presents itself in this fashion: How far can I, in addition to my labors in a technical field, make myself expert in social problems, sufficiently so to feel justified in expressing confident opinions, and leading those who may wish to follow me. It may be replied that, in our society, organized as a democracy, we cannot evade these problems, and are doing something even by doing nothing. But the scientific man will reply: I do try to be a good citizen, and I do act in public affairs, but not feeling expert, I follow the lead of those who have given the subject more attention. His reaction to religion is apt to be very much the same, with the result that his economics, his morality and religion seem sometimes to be the product of a totally different sort of mind from that which is back of his scientific papers.

There is room for difference of opinion, and it is hard for the scientific man to visualize himself as a heaven-sent savior of erring mankind. Practically, it is very difficult for a scientific expert employed by the public (as in a state university) to be always sure that he is rendering public service. He deems it his business to supply information or give advice to the limit of his capacity, on request. Can he determine what will be done with this information or advice, or attempt to withold it if he suspects the possibility of undesirable results? He necessarily has to treat all comers alike, and cannot honorably do otherwise.

Having thus presented some of the difficulties, I hasten to say that in spite of them all, I have no doubt that the scientific habit of mind is essential if we are to deal wisely with our social problems, and that even some of our poorly trained (in a social sense) scientific men could be made very useful in the present emergency, having at any rate a knowledge of the technique of successful investigation.

DR. MERRIAM'S statement:

AS point of view is an important element in any discussion, it should be recognized that this is written from the position of one trained in science. But, dangerous as is exploration by a scientist in the field of human values, it is also true that unless students in scientific subjects join with investigators of human problems to study relations among the several regions of thought, there is small hope for solving some of the questions for which we most urgently need understanding.

In ways not yet devised we need development of research, education, and vision which will give us machinery making possible the continuing evolution of society through creative activity, but without increasing the dangers. Such a program will necessarily involve participation of science and engineering in its various phases, along with representation of all social interests concerned.

The control of new features will in many instances require a view such as can be obtained only by wisdom of the highest order. Perhaps we shall need

"Greed, dishonesty, distrust "

DR. ABBOT

the collective judgment of many minds related in an exceptionally effective way. In other cases the necessary action may arise from individuals concerned. To depend wholly upon values remaining through survival of the fittest, allowing things to take their course unguided, will sometimes involve fate of the product and on other occasions the interests of the people. Errors of ignorance in handling of such situations will be multiplied by bad judgment, and may be increased almost infinitely by selfishness or neglect of the public interest.

MR. KETTERING observes:

THERE are many people who doubt if human progress can continue on its present standards. Still others think that we have to go back to lower standards of living because they see no way out of our present difficulty. There are, however, a substantial number who, knowing something of the development of civilization, do not regard the evidence presented as justifying either a static or a retrograding standard of living. We do not believe the world is finished or that we must curtail human effort and desire. The only way out of our present difficulty is forward and not backward.

To those of us who have spent most of our time in experimental and de-

(*Please turn to page* 107)

UNFORESEEN CONTROL OF INDUSTRY

By DANIEL H. KANE
N. Y. Bar

TWENTY years ago, not long prior to the beginning of the World War, the wheels of American industry were turning slowly. We were entering upon a period of business depression which, economists tell us, never reached its lowest ebb due to the industrial stimulus of the war. The popular hobgoblin of that era, which was generally regarded as the cause of all economic ills, was the giant of industry—the so-called trust.

This concept of the evil of monopolies was not a new one, for combinations in restraint of trade were frowned upon by the common law, and the Sherman Act of 1890 provided means for causing disintegration of such combinations or monopolies. However, it was generally believed that further legislation was necessary to prevent the additional concentration of industry in the hands of a few large concerns. This popular belief bore fruit in 1914 in the second session of the Sixty-third Congress, which was devoted largely to the consideration of additional anti-trust statutes and resulted in the Clayton Act which extended and further defined the anti-trust laws, and in the Federal Trade Commission Act which created an administrative board for carrying out some of the provisions of the anti-trust acts and for preventing those practices which it was believed inevitably destroyed competition and fostered monopolies.

THE Federal Trade Commission Act provides for the creation of a commission of five members not more than three of whom may be of the same political party. The most important powers of the Commission are those granted by Section 5 of the Act, which declares unfair methods of competition to be unlawful and grants the Commission power to prevent them. This section provides:

> "That unfair methods of competition in commerce are hereby declared unlawful.
>
> "The commission is hereby empowered and directed to prevent persons, partnerships, or corporations * * * from using unfair methods of competition in commerce."

The statute does not define the clause "unfair methods of competition" but a review of Vol. 51 of the Congressional Record shows that Section 5 was aimed directly against the creation of monopolies and that by unfair methods of competition was meant those practices tending to create monopolies.

The Act further provides that the Commission may institute proceedings where it has reason to believe that a person, partnership, or corporation has been using unfair methods of competition in commerce and where it appears that such proceedings "would be to the interest of the public." The party so proceeded against is given an opportunity to appear before the Commission to answer its charges. In such proceeding both the Commission and the party may take testimony and if the Commission after considering the testimony is of the opinion that the party has employed unfair methods of competition, it must make a report stating its findings as to the facts and must serve upon the party proceeded against an order requiring him or it to cease and desist from using the unfair methods of competition.

IT will thus be noted that the Commission is empowered to act in effect both as prosecutor and judge, and if its order were final and not subject to review there would be grave danger of injustice being inflicted upon some of the parties proceeded against, to say nothing of the question of constitutionality. The section, however, does provide for two methods for obtaining a limited review of the Commission's order by a United States Circuit Court of Appeals. Either the Commission, where the party proceeded against refuses to obey its order, or the party, may apply to certain of the Circuit Courts of Appeals, and the court, after considering the entire record of the proceedings before the Commission, may enter a decree modifying, affirming, or setting aside the order of the Commission.

However, in reviewing the Commission's order, the court cannot independently weigh the evidence and arrive at its own findings of fact since its powers of review are strictly limited by a provision in the Act that "the findings of the Commission as to the facts, if supported by testimony, shall be conclusive." In other words, if there is any conflict in the testimony, the Commission's determination as to what the facts really are, if supported by testimony, is final and binding upon the Circuit Court of Appeals regardless of the amount of evidence to the contrary.

The court may merely review the questions of law and determine whether the findings of fact of the Commission are supported by any substantial testimony. Thus it will be seen that while the Act provides for a method of obtaining review by the courts of the Commission's orders, it puts a definite limitation upon that review.

The provision that "the findings of the Commission as to the facts, if supported by testimony, shall be conclusive," is obviously unfair in all those cases where an important fact is in dispute and where both the Commission and the party proceeded against introduce evidence to support their respective contentions, inasmuch as it denies the party an adequate review before an impartial tribunal and makes the Commission not only the prosecutor but also the final arbiter of any facts thus in dispute. Naturally, a body having prosecuting powers is liable from time to time to become over-zealous and its enthusiasm as a prosecutor may occasionally affect its decision as an adjudicating tribunal.

More serious than this, however, from the standpoint of the average business man, is the fact that it places in the hands of the Commission a power which might enable it to exercise functions which Congress never intended it to exercise and become in effect the dictator of the proper meaning of commercial names and brands. It enables the Commission to step in when the meaning of a name or brand is uncertain or open to dispute, decide what in its opinion is its proper meaning, and order the party proceeded against to stop using it in any other manner.

IN such cases the Commission is not preventing those unfair methods of competition which tend to create monopolies but becomes in effect a bureau of standards with power to standardize the names and brands of goods used in commerce. However desirable it may be to secure the standardization of names, Congress certainly never intended to grant such powers to the Federal Trade Commission.

It is a far cry from preventing those unfair methods of competition which have a capacity and tendency to create monopolies, to standardizing and interpreting the meaning of uncertain and disputed names and terms. This unusual and unforeseen degree of control over industry which might result at times in depriving a business concern of the right to use a name which it has used in good faith for many years,

exists only because the courts are denied a complete review of the facts in each case.

There is a recent case somewhat at point. The Commission filed a complaint against a rug manufacturer charging that it manufactured and sold in interstate commerce certain rugs and misbranded them as Wilton rugs under the trade name "Bagdad Seamless Jacquard Wilton." Summarized, the findings of fact of the Commission were that the respondent had been selling its Bagdad rugs as and for genuine Wiltons; that the term "Wilton" as applied to a rug fabric implied a fabric having a weave construction in which the warp pile yarns, when not required upon the surface of the design or pattern, are continued in the sub-surface structure of the fabric, and that the respondent's Bagdad rugs were made under a process essentially unlike that used in making Wilton rugs and when made consist of a weave structure differing materially from that of Wilton rugs.

THE Trade Commission then made the conclusion of law that the sale of the Bagdad rugs as and for genuine Wiltons constituted an unfair method of competition in commerce having a capacity and tendency to deceive the public. Upon these findings and conclusion the Commission ordered the respondent to cease and desist from designating its Bagdad rug as a Wilton rug.

The Circuit Court of Appeals for the Third Circuit, in reviewing the order, found that no Wilton rugs manufactured today are similar in all respects to those originally termed "Wilton" more than 100 years ago. Both the Commission and the respondent introduced a great deal of testimony, the testimony presented by the Commission naturally sustaining its definition of a genuine Wilton rug, and the testimony presented by respondent sustaining its contention that the Bagdad rug had all of the essential characteristics of a genuine Wilton. The court in considering the conflicting nature of the testimony found there was ample evidence to support either the respondent's or the Commission's contention as to the meaning of the term "Wilton," but that since the Commission's finding as to its meaning did have evidence to support it, it was conclusive. In its decision the court made this significant statement:

> "Since the statute and decisions expressly confer upon the Commission and not upon the court the duty of determining the facts, it is of no consequence that if the Congress had conferred fact-finding power upon the court, it might have reached a conclusion other than that of the Commission."

Thus the court indicated that if it had full power to appraise the testimony, its finding as to the meaning of the term "Wilton" might have been different from that of the Commission. Under the law the court was forced to affirm the Federal Trade Commission's order.

Here is a case where no rug manufacturer makes rugs similar in all respects to the original Wilton and where there was substantial evidence sustaining both the Commission's and the respondent's contention of the proper meaning of the term "Wilton." There is the distinct possibility that the term "Wilton" was entitled to the interpretation which respondent sought to give it, and yet the court being bound by the findings since they were supported by evidence, could not make its own appraisal of the testimony to determine whether this were the case. The Commission was, therefore, both the prosecutor and the final judge of a vital fact regarding which the testimony was in conflict.

Where the meaning of a brand or name is not fixed and is subject to several interpretations and the respondent uses it in accordance with any one of its accepted meanings, he certainly is not guilty of an unfair method of competition within the meaning of the Federal Trade Commission Act; and yet if the Federal Trade Commission should decide that the brand or term, even though having been used for a long period of years, has a fixed meaning and designates a particular type of goods, and that the respondent was using the term to designate a wrong class of goods with an injurious effect upon competition, and should these findings be supported by evidence, they would be conclusive and binding upon a Circuit Court of Appeals regardless of the amount of evidence to the contrary.

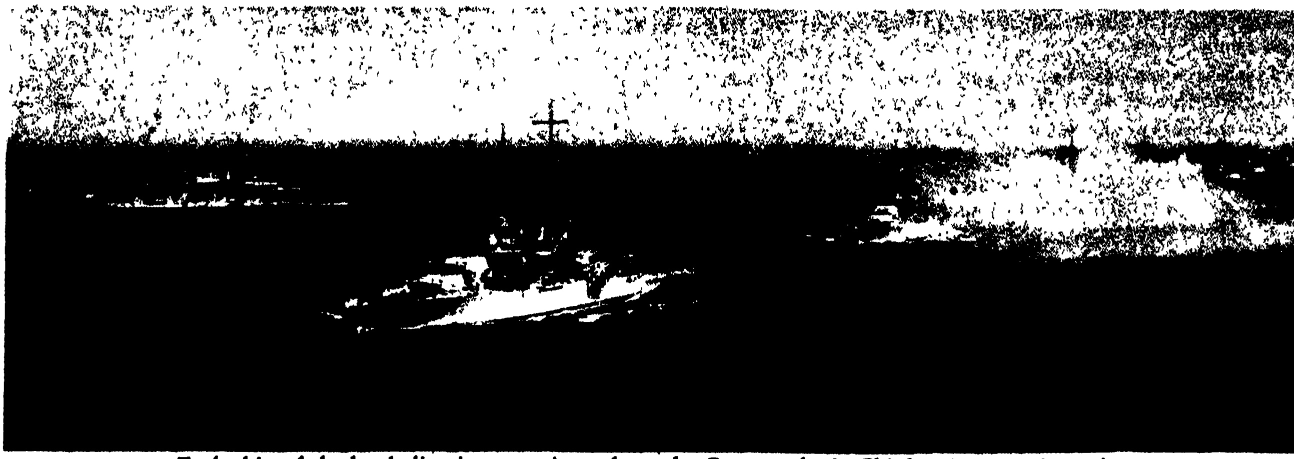
WOULD you, as a business man, care to have a government bureau decide upon the name or brand by which you may designate your goods? Should a government board or bureau be empowered to deprive business concerns of names or brands which they have used in good faith for many years? These questions are not merely hypothetical, nor are they based upon some imaginary grant of power threatened by some member of the so-called brain trust. The Federal Trade Commission, created 20 years ago, was granted power which enables it to do just these things. Its powers of regulation extend to every concern engaged in commerce. The accompanying article points out that in its proceedings the Commission acts not only as prosecutor but as judge, and the party proceeded against is denied adequate review of its decisions since its findings of fact or its interpretation of the evidence, if supported by testimony, are made binding upon the court reviewing its proceedings. It is remarkable that a board having such tremendous powers over all phases of industry should have attracted so little attention in the past.—*The Editor.*

IN every case where the meaning of a name is in dispute, there are at least two sides to the question, and evidence can be adduced to support each side. The Commission in instituting the proceeding for the misbranding of goods indicates by its very action in instituting that proceeding that it believes the respondent is using the brand wrongly. Usually it should have little difficulty in securing evidence to sustain its position.

Where the respondent is using a brand or name subject to several interpretations or whose exact meaning is open to honest dispute, the provision that "the findings of the Commission, if supported by testimony, shall be conclusive," may lead to serious injustice. To prevent such injustice, to enable respondents in such cases to secure a complete and adequate review by the courts, and to prevent the Federal Trade Commission from overstepping the powers which Congress intended to give it and become in effect a bureau of standards with power to compel obedience with its standards, the Federal Trade Commission Act should be amended so as to give the Circuit Court of Appeals reviewing the Commission's order the power of independently weighing the evidence and making its own findings which is usually accorded to such a court in reviewing the decree of a court of equity.

The activities of the Federal Trade Commission are not confined to the regulation of public utilities, nor are its activities confined to the supervision of monopolies or trusts in spite of the fact that the Trade Commission Act was originally passed as a supplement to the anti-trust laws. Every business engaged in the sale of goods in commerce is potentially subject to the supervision of the Commission.

The American system of checks and balances to prevent the possible arbitrary use of power might well be applied to control the use of a power which affects the rights of so many people. Certainly it is not unreasonable to request that the same check be placed upon an order of the Commission which, it must be remembered, acts both as prosecutor and judge, as is placed upon a decree of a court of equity.



Each ship of the battle line in succession salutes the Commander-in-Chief as it passes in review

WHY THE BATTLESHIP?

By JONAS H. INGRAM
Commander, U. S. Navy

IN recent years the American public has from time to time seen much controversial material relative to the battleship as an obsolete weapon of naval warfare and at the same time advocating the construction of aircraft and less expensive surface craft as the logical substitute.

As the time approaches for the next naval conference, the sequel to the Washington Limitation conference of 1921 that established the naval ratios, every American citizen should have an intelligent understanding of the issues to be faced at this coming world naval conference. The relative size and armament of battleships will undoubtedly be one of the questions of vital interest to our national welfare and security.

The viewpoint of the men who have been educated and trained in, and have given their life's work to, the subject of the nation's first line of defense, may be of interest to those who are formulating an opinion on this important subject.

In the naval service it makes little difference as to whether an officer wears on his uniform the wings of a qualified naval air pilot or observer or just the plain navy blue, as both occupy important positions in the first line. There is no argument between these men as to their relative importance in carrying out their respective assignments.

To those who have been in the Navy for years, the first submarine and the talk of how it would revolutionize sea warfare, the first torpedo boat, the first destroyer, the first battle cruiser—all to bring about a new order of things—are now but memories of the past. All these are important units in their place and to them it is difficult to assign numerical importance.

WITH the manuscript of this article, the first of two on this subject, the author submitted endorsements of the battleship as the backbone of our sea power by Secretary Swanson, Admiral Standley, and Rear Admiral J. K. Taussig.

In command of the *Pennsylvania* during her modernization, executive and temporary Captain of this ship while she was fleet flagship of the United States Fleet in the Pacific, Commander Ingram knows battleships. He was also Senior Aide to Admiral Hugh Rodman in the *New York* while she was attached to the British Grand Fleet for 14 months during the war and Admiral Rodman's Assistant Chief of Staff when he was Commander-in-Chief of the Pacific Fleet.

Now man has succeeded in mastering the air, with a powerful, elusive, and swift weapon that must be given due weight in the combat at sea.

As a result, the naval strategist has at hand many types, different in speed, weight, and vulnerability. He faces much the same proposition that a football coach does at the start of a season. He must build up a team that in order to be successful must have both offensive and defensive strength. He needs power and weight in the line that can take and give punishment, fast wings that can get down the field, catch passes, and still have defensive strength in turning in or blocking end sweeps. He must have backfield power that can make quick stabs and thrusts, with chances of breaking through; fast end runners; kickers; passers; and types adept at spinners and complicated reverses. These same types must be able to block, defend against passes, and be able to defend against any type of an offensive team. In a comparable manner we have types of ships and aircraft, all good in their place, but one excels the other, depending upon the offensive or defensive requirement.

HENCE a well-balanced fleet may be compared with a football team. There must be heavy powerful linemen—the battleships. The ends are the aircraft carriers and cruisers; the backs, cruisers; while heavy ships and destroyers are carriers for passing; submarines for trick plays and reverses.

To make up this fleet there must be sufficient replacements and substitutes, their use depending upon weather conditions and type of adversary. If we face an enemy who has only one type of offense, the answer to our problem is simple. But our most probable enemies are well equipped in offense with many types. They do not care to be hampered with eligibility rules as to their types and numbers, and in some cases there is a grave tendency to in-

crease their power and numbers and engage in a race for sea strength.

To face this situation, the men who carry the responsibility for the safe defense of this country cannot be stampeded or prejudiced against any particular type. They must take into consideration our probable enemies, effectiveness, strategy most likely to insure success, our naval policy, the economic problems, geographical considerations, the element of time, and have full deference for any limitations of armament treaty to which we may be a signatory.

It has often been quoted that a good offense is the best defense, but this country has never, nor probably will ever engage in a war of aggression, so our first need must be an adequate defense against any probable enemy.

In case of hostile attack, our directing genius must know the composition of enemy forces and from the circumstances determine the course of action; for the ultimate mission of our fleet is to seek, engage decisively, and destroy the enemy.

A GOOD modern naval officer must be air-minded to a high degree. He must be fully alive to the uses and effectiveness of our air service as well as its limitations, and, contrary to public opinion in general and some air-minded writers in particular, the average United States naval officer has a full appreciation of air values and their relations to the whole, the reason for this being that our airmen come from the same school and work in close harmony with their brothers on surface ships and submarines. They work out their problems together, discuss every phase so each has a comprehensive view of the other's problems and difficulties at sea. The air force operates as a part of the fleet in the same manner as the destroyer force or submarine force. Each makes his contribution to the team work of the whole fleet and, be it in offensive or defensive action, they all have equally important rôles to play.

Great problems are evolved to give each arm of the fleet an opportunity to develop. All branches join in the solving of the problem and as a consequence there is splendid teamwork in developing a strong and aggressive fleet prepared to cope with any situation it may be called upon to face. The responsibility for the strength and composition of this fleet rests solely with Congress. It is the duty of the Navy to advise and be on sure ground, with the best interest of the country at heart, in every recommendation to Congress.

On the other hand, our citizens should be alive to our situation at sea and have a general knowledge of some of the problems faced and not be in a position to be led astray by some popular catch

"The New Dealers for the Navy:" President Roosevelt, Secretary of the Navy Claude A. Swanson, Chief of Naval Operations Admiral Wm. H. Standley, and the Ambassador to Mexico, the Hon. Josephus Daniels, who was Naval Secretary under President Wilson—at President's review, New York, May 31, 1934

phrase or some snap judgment opinion given by someone without responsibility. For example, quite a bit of publicity has been given the contention that the advent of aircraft has made obsolete all surface craft, particularly the battleship. This statement is not a fact and cannot be substantiated. Though a picturesque indictment may be made of the battleship or other surface craft by those not well informed, the problem is fundamentally a technical one and the rational discussion of the subject must be from this angle.

What is generally known as "sea power" comprises the total strength of a nation in (1) combatant ships (surface, sub-surface, and air); (2) merchant marine; (3) naval bases—all essential and important in the final analysis. We are known to be weak in both merchant marine and naval bases; therefore our combatant fleet must be built and maintained having due regard for these inherent weaknesses.

Lack of a merchant marine demands a different type of cruiser. Nations having fast merchant vessels have a great advantage, as these vessels may be easily armed and turned loose on the world's trade routes and make ideal commerce destroyers, scouts, and raiders. To combat this menace, our Navy must have heavy cruisers of great speed and large cruising radius, with superior armament, able to make safe our overseas commerce from such attack.

Lack of bases outside the continental limits have a direct bearing on our naval policy and strategy. The great distances between our coasts, the Panama Canal, Alaska, and our insular possessions, make it imperative that our combatant forces have great radius of action, seaworthiness, and the power necessary to make and maintain temporary bases to protect our light craft and aircraft from strong enemy opposition.

Full weight and consideration must be given to these factors by the men responsible for the design, construction, and numbers of the different types of fighting craft that make up this combatant sea force.

A reasonable question that is often asked is: If other nations wish to abolish or limit the size of battleships, why should the United States not agree? Great Britain has naval bases scattered all over the globe with a large, powerful, and swift merchant fleet and great numbers of small cruisers that are most effective when operating from convenient and well placed bases. Japan also has numerous island bases. It would be advantageous to both of these nations to have a definite limitation upon the number and size of battleships, which would react to the disadvantage of our own naval policy founded upon the battleship as its backbone. We have really only one location for such a real base on our west coast, far removed from Alaska, Panama, and the Hawaiian Islands.

IN the design and construction of a man-of-war the constructor faces a compromise from the minute he draws the first line. Our idea of offensive power is long-range guns of high caliber, speed, long radius of action, spotting planes, and latest fire control equipment. Defensively, there must be heavy armor, excellent water-tight integrity, protective decks, anti-aircraft and submarine defense battery, plus gas protection. Big guns and armor mean weight; ammunition adds to tonnage; every extra knot in speed requires more boiler power and machinery weight; intricate compartmentation is a weighty proposition; cruising radius means more fuel; fire control equipment, anti-aircraft and anti-submarine batteries will add to the total. Planes and catapults are big

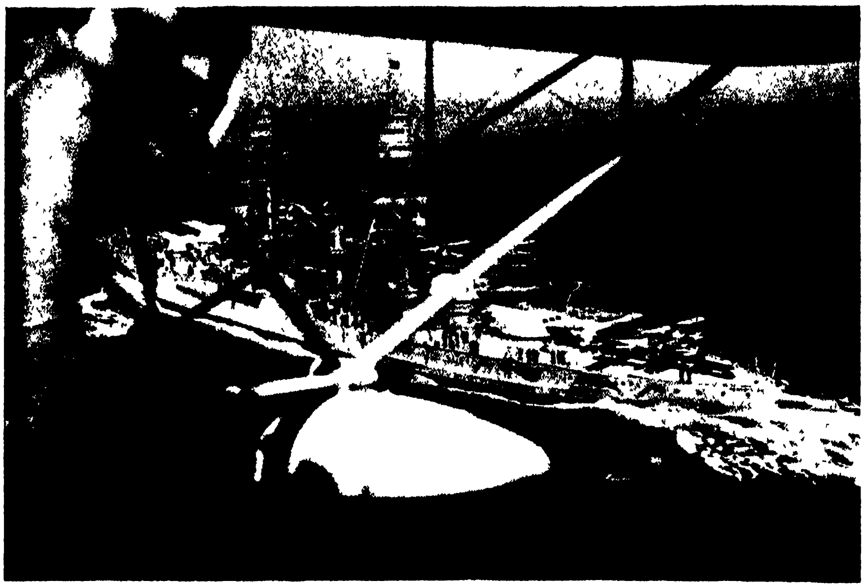
items; space and quarters for a contented crew call for additional room; blisters and protected decks bring the total up to the point that, even after every cut and compromise, the naval architect finds he has a ship with a tonnage aggregating 35,000 tons, the limiting tonnage arrived at by the Naval Limitation Conference. Great Britain has two great ships, the *Nelson* and *Rodney*, that exceed this figure by about 6000 tons.

At the time of the Washington Conference in 1921, the naval architects of the world were gradually increasing fighting strength by building ships of great gun power and greater tonnage. One of the outstanding accomplishments of this conference was the limitation in size of men-of-war and the agreement to curtail further building of battleships until the next conference in 1935.

WITH the limitation on tonnage, increased strength must come from superior skill in design, superior technical developments in engineering, metallurgy, and airplane spotting, increased efficiency in ordnance and fire control equipment, and increased protection from overhead and underwater attack. It really has put a premium on skill and scientific development.

The fact remains, however, that the battleship has not become obsolete and with due consideration given to the latest developments in heavy cruisers, air force, and submarines, the battleship yet remains to the Navy what the infantry is to the Army. The battleship has the greatest offensive and defensive power of any type of ship. It has great gun power to deliver the heaviest blows; heavy protective armor to withstand gun, torpedo, and bombing attacks; latest devices for withstanding attacks from the air, on the surface, or from under the water; and is so constructed that it can remain at sea in any weather for long periods and be capable of operating at great distances from bases.

In this discussion one should not consider the individual battleship but rather what is known in naval terms as the battle line. This consists of the units that would at all times accompany the battleships at sea and consists of battleships present, screening destroyers, cruiser screen, and aircraft carriers. This formation is strongly defensive against any attack and at the same time presents the greatest offensive power.



The U. S. S. *Pennsylvania*, flagship of the United States Fleet. This aerial photograph shows four planes and two catapults, also the hull's blister protection

The battle line may at any time be augmented by the entire cruiser, destroyer, submarine, and air force and then we have a fleet concentration.

There are few problems in life to which history does not give the basis for the correct answer. The late war showed —in fact, all of our great peace-time naval maneuvers show—that the battle line, composed of the heavy ships of the line, is the focus of all offensive and defensive operations. No matter what the conditions of the problems or what types of units are involved, their offensive action radiates from the position occupied by the battle line; when the going is hard they invariably fall back on the battle line for protection.

The real command of the sea will be dictated by the strength of this battle line. Naturally it will have to be supported by the various other units that contribute their full share to the whole, but the final decision will rest with the capital ship for the simple reason that the force having a battle line supported by light forces having an adequate air force can "go places and do things" where light forces alone could not.

There are many practical illustrations to support this view. In the North Sea during the World War there was a vital supply of food stuffs coming into the British Isles from the Scandinavian countries—huge convoys of slow vessels coming from Bergen, Norway, to the east coast of England. Even in a relatively small body of water such as the North Sea, the Germans made successful raids, with light forces, on this convoy. In the end the British High Command ordered a squadron of battleships of the Grand Fleet to act as escort for this convoy on their slow passage across. This immediately stopped all raids as Germany could not afford to molest this convey with light forces—including battle cruisers—and, until the conclusion of the war, this convoy came in unmolested each week.

IN our own war games, one would only have to be present once and observe the results to see how powerless our light forces—including aircraft and our new eight inch gun cruisers—are when contact is made with our battle line.

The defense of the battle line against hostile aircraft attack is their accompanying aircraft, their anti-aircraft protection, and, finally, fine deck protection against the possibility of the enemy aircraft breaking through. From submarine attack the defense again is our own submarines, guns, aircraft, and destroyer screens—and battleship "blisters" should a torpedo hit be made. Hostile battle cruisers and light forces cannot afford to come within extreme range of the heavy caliber guns.

The result of this effectiveness of the battle line is that our first line of defense would be far-flung from our own shores, comparable to heavy entrenchments occupied by infantry. This line would be effective in breaking up air raids that must come by water-borne transportation from the sea, giving our own light forces a point to operate from and to fall back on when meeting superior strength. In fact, the battle line always has been and will continue to be the backbone of our seapower.

What the limiting size of the battleship of the future will be, no one can predict. It will in all probability be decided in conference with the sea powers of the world. Each country will have opinions of its own. The economic situation will have weight. The political situation existing in the world at the time will exert an influence. But it is safe to say that the United States with our extensive coast lines, distant insular possessions, the Panama Canal, and the Monroe Doctrine, cannot afford to give up a ship that embodies the greatest offensive and defensive power and is in reality the powerful line upon which our sea team and its strategy have been developed.

BUREAUCRACY AND THE FARMER

By HARRY F. BYRD
United States Senator from Virginia

I AM a Democrat. I believe in party government. I have supported many emergency measures granting great power to the President. I respect the high patriotism and benevolent intentions of the President and admire many of his great achievements; but there remains in me enough of the spirit of Thomas Jefferson to insist that extraordinary powers now granted shall be limited to the period of this economic emergency and that reasonable restraints shall be placed upon the exercise by Federal bureaucrats of dictatorial powers.

Holding this democratic faith I opposed amendments to the Agricultural Adjustment Act—urged for adoption by the distinguished Secretary of Agriculture— that would (if adopted) make the Secretary a supreme dictator over everyone who produces agricultural products and everyone who handles such products.

Congress approaches adjournment as this is written and the indications are either that these amendments will not pass at all or that most of their objectionable features.... (Amendments were defeated.—*Ed.*) However, the consideration of the powers sought for the Secretary of Agriculture illustrates the dangerous tendency of Washington bureaucrats to grasp and enlarge their powers and points the moral of this brief contribution to SCIENTIFIC AMERICAN.

I HAVE not hesitated to support legislation designed reasonably to assist the orderly and profitable production and marketing of farm products; but I opposed an amendment that gave the Secretary power to prescribe what a farmer may plant and what he may receive—even what turkeys and chickens he may raise—in his entire farm operations, once he has agreed to accept government compensation for reducing his planted acreage on any part of his farm, however small.

It was proposed that the farmer must obtain a license to farm his own land. The Secretary would then dictate the terms of that license and failure to observe the terms would be punishable by fines as high as 1000 dollars a day, if the hapless farmer were convicted.

After dictating the operation of the farm by the farmer it was contemplated by these progressive regulators that the Secretary dictate the terms upon which food products from the farm might be distributed. The distributor or handler of such products must also obtain a license and no one without a license could ship agricultural products in interstate commerce.

IN carrying out the declared policy of the Act it was provided that the Secretary might impose quota restrictions, with the approval of two thirds of the producers of a given commodity, and, even without such approval, the Secretary was empowered to direct to what markets and to what extent certain products might be shipped. Add to this the power to prescribe the quantity of each commodity such distributor might sell and the Secretary would in effect possess the power to fix the price of agricultural commodities.

The growth of the power of Federal bureaus has been remarked for years as a dangerous invasion of the liberty of the individual. Of course, commissions are necessary to the orderly administration of transportation and industry, operating on an interstate scale too vast and extensive to admit of effective regulation by state agencies. But this admission is not inconsistent with the insistence that powers vested in Federal bureaus are powers dangerous to the free play of individual initiative and individual enterprise and that the real Democrat must demand strict limitations on such powers.

Especially must the Democrat insist that such administrative commissions and bureaus keep strictly within the powers granted to them and that the courts be free to protect the constitutional rights of the individual when he suffers by subjection to the arbitrary decisions or acts of a Federal bureau.

I admire the many men who work hard and patriotically on these commissions. Most of them are benevolent in their intentions; but their immediate objective is to justify their official existence by manifest results. They believe in the beneficence of their work and they tend to absorb progressively the power they deem necessary to do their work.

The powers of many of these Federal bureaus are veritably kingly. One reason is that the gentlemen who preside over these commissions are delegated the authority to make regulations to govern their work and it is very difficult for the individual to persuade even the courts to extricate him uninjured when he is caught in the mesh of one of these regulations.

The complaining citizen will be told that Congress has delegated to the Commission the right to make regulations essential to efficient administration and that these regulations will be sustained if made in accordance with the law. Even more, the bureau's own construction of an Act of Congress will be sustained by the courts unless it is clearly erroneous. In theory, unconstitutional rules and unconstitutional legislation will be declared invalid by the courts, but, in practice, administrative rules of the bureau, effectively enlarging its powers, will be sustained unless clearly erroneous. Then, too, only the well-to-do citizen can finance a law suit to test his complaint that a great Federal bureau has invaded his constitutional rights.

THE complexity and magnitude of modern business require regulation by Federal bureaus undoubtedly; but it remains as true today as it was when Jefferson said it, that the individual possesses certain fundamental rights that are "inalienable." Even the King of England, in the old days of more absolute monarchy, could not enter uninvited the cabin of his poorest subject, and yet, many of these bureaucrats, attired in plain clothes, exercise more power under a straw hat than did the king of old adorned with a jeweled crown. Americans today must keep watch and ward over the liberty of the citizen to go about his own business with that degree of ordered freedom that has enabled him to develop here a strong nation of strong men happy in the enjoyment of liberty protected by law.

When you put men in regiments and drill their steps you gain power in mass momentum, but you stifle the initiative of every individual who may advance the progress and welfare of us all if given free play to his talents and enterprise. The modern American may have to surrender a measure of his independent action to the social necessities of these hard times, but he should never consent to be awakened each morning by the blare of a bureaucratic bugle and required to do his daily work to the tap of a bureaucratic drum.

Dispelling Popular Fallacies About

AIR CONDITIONING

By L. R. SMITH
Air Conditioning Division, Westinghouse Electric & Manufacturing Company

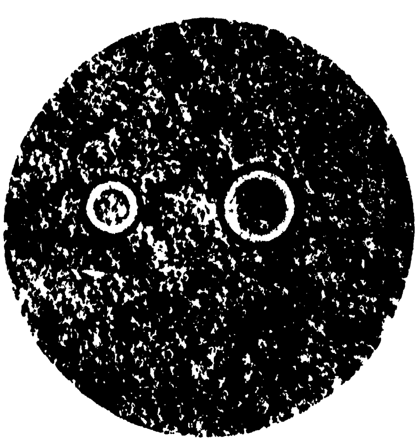
"It isn't the heat; it's the humidity"

THERE are many popular misconceptions regarding the new science of air conditioning. It has been promoted largely by partial truths or so-called "commercial truths." Such statements as, "Air Conditioner Complete for $25!" and "Our Complete Air Conditioner Requires Only Two Square Feet of Floor Space!", on investigation turn out to be descriptive of a humidifier, a fan, a heating cabinet, a cooling cabinet, an air filter, an odor remover, or even an air scenter. Much can be accomplished in combating such fallacies by supplying adequate equipment and by proper representation of air-conditioning products.

The public, in its search for information on air conditioning, may be likened to a group of blind men examining an elephant. Some feel the bulk of the air-conditioning elephant and say: "Air conditioning is temperature control"; others receive a spray of water from its trunk and declare it to be humidity control; still others feel the flap of its ears and are sure it must be air circulation. True and complete air conditioning is not to be confused with any one part of the whole.

One of the most difficult phases of air conditioning and one of the least recognized as such, is that of dust removal. Air filters are often guaranteed to remove 98 percent of the dirt in the air. Investigation usually discloses that a special dirt is used in the tests in order to obtain such high efficiencies. It is relatively easy to remove large particles, but the major portion of atmospheric dust in residential districts is extremely small. The unit of length used in dust measurement is the micron. (The micron is one millionth of a meter or approximately one twenty-five thousandth of an inch.) Much of our atmospheric dust is from 1/10 to 1 micron in diameter.

Dust particles, if composed of soot or material of like specific weight, and of one micron mean diameter, will fall freely at about the rate of six inches per hour. At this slow rate of fall, the particle follows almost perfectly the flow of air surrounding it. The impingement principle of dust filtering attempts to separate solid particles by substituting a new acceleration for that of gravity. The rate at which the direction of the air is changed must be extremely rapid in order to separate such small particles. This explains why, as yet, so few mechanical filters show good efficiency on atmospheric dirt. Water sprays are likewise relatively ineffective for these very small particles. People are perhaps the best filters, tests revealing that 100 percent of the dust inhaled under normal atmospheric dust conditions is retained.



Photomicrograph showing dust after passing through a good mechanical filter. Large particle, in large circle, is 40 microns in diameter; other particles, as in smaller circle, average about one micron

In July, 1932, an investigation in New York City disclosed that approximately one pound of dirt existed in every 50,000,000 cubic feet of air in that city. In July, 1930, in the same city, the average dirt concentration was nearly three times that amount. Any well-constructed house will have an air infiltration equal to one complete air change per hour. This means that 42 to 100 ounces of dirt will filter into a 15,000 cubic foot house per year. It is difficult to imagine how many square feet of cotton cloth used in some air filters would be required to hold this quantity of dirt. This is not to discourage the use of any type of filter, as many air filters even of low efficiency will remove the larger dirt particles which readily settle out of the air. Avoiding heavy dust concentrations, but living in an industrial city, a person probably inhales from four to ten ounces of dust during his life span.

IN attempts to simplify the myriad aspects of air conditioning for human comfort, charts have been prepared. Valuable as such a chart is, its limitations should be recognized. First, the chart applies only when the people in the room are physically inactive. Second, it is for air conditions within a space where the surrounding objects are at the same temperature as the air. Comfort may be had at temperatures many degrees below those given in the

A good commercial air filter partly filled with dust from the atmosphere

chart provided that the walls surrounding us are at a higher temperature; similarly, cool objects around us permit higher air temperatures without discomfort. And third, effective temperatures are to be recommended as an indication of comfort only between the humidity limits of 30 to 70 percent.

MANY people, upon inspecting a comfort chart, conclude that a substantial saving in heat may be effected by lowering the temperature, raising the humidity, and maintaining the same effective temperature. However, the heat required to evaporate water for maintaining a higher humidity was probably overlooked, and usually offsets the expected heat saving. The real way to save heat is by the use of proper insulation and a reduction in air infiltration.

A popular practice is to place pans of water about a room or on the hot-air registers to raise the humidity during winter. Actually, during severe winter weather, gallons of water must be evaporated per day to increase sensibly the humidity in even a moderate sized dwelling.

The quantities of coal, gas, or oil required to heat dwellings are roughly known to the public. However, most people are easy prey to salesmen selling a small box capable of holding, say 50 pounds of ice, for cooling rooms. Practically, any house of approximately 15,000 cubic foot capacity, located where the temperature often becomes 95 degrees, Fahrenheit, requires about 50,000 B.t.u. cooling per hour for real comfort; which corresponds to the melting of approximately 350 pounds of ice per hour!

To produce adequate cooling with electrical mechanical refrigeration units, about six kilowatts of electric power are required for cooling an entire dwelling. To produce cooling by means of heat directly, as in the case of the steam jet or absorption systems, more heat is usually required than is necessary to heat the same dwelling in winter.

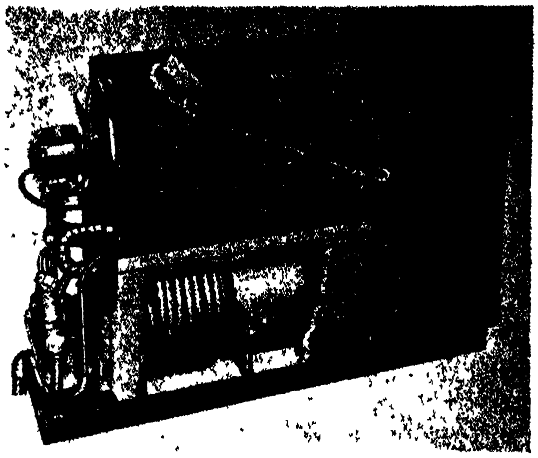
People often wonder why heating a certain residence to 70 degrees, Fahrenheit, with an outdoor temperature of 0 degrees, Fahrenheit, requires only 100,000 B.t.u. heating per hour, while to cool it a mere 10 degrees, Fahrenheit, below the outside temperature, 50,000 B.t.u. of heat per hour must be removed. The extra heat consists of that required to remove water vapor from the air, that caused by the sun shining on the walls and windows, and that generated inside the dwelling, as from people.

Some "air conditioners" are represented on the basis that by the addition of a small amount of equipment, cooling can be obtained. Upon inquiry, it develops that one of the most expensive parts of the complete system has been omitted. Many think that by simply placing a cooling coil in a hot-air heating system, with equipment to provide the cooling, the resultant air circulation will be completely satisfactory. Such happy circumstance is rare, because of the tendency of cool air to fall instead of rise as in the case of hot air. A proper air conditioning system has to be designed to give good air distribution for both heating and cooling.

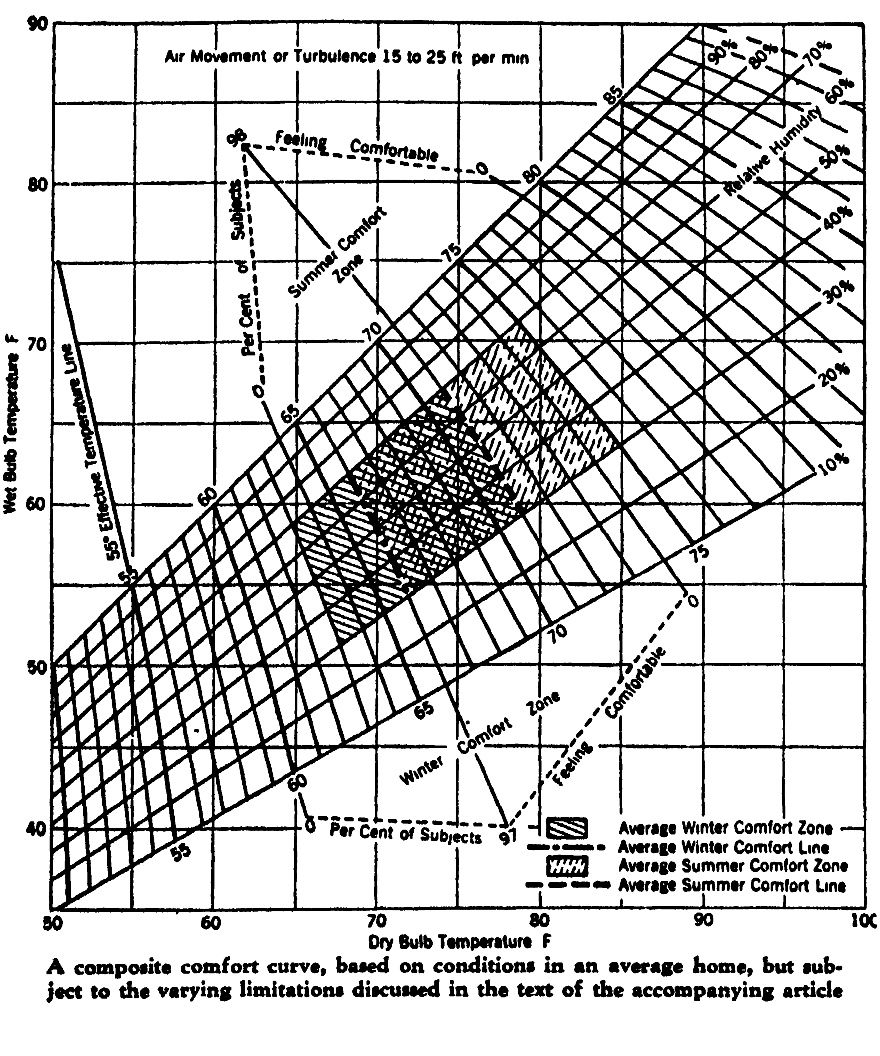
THERE is the impression that air cannot be given a velocity greater than about 300 feet per minute without noise. Specifications for air-distribution systems in public and private buildings often require that the velocity at which air is delivered to a room must not exceed this value. The real criterion is the actual noise produced.

Other phases of air conditioning such as odor elimination and "vitalization," whatever that is found to be, are rapidly gaining public attention. When it is found possible greatly to reduce air infiltration or fresh air brought in, a material saving in operating costs of air conditioning may be accomplished. The air from outside must be partially conditioned by regulating its cleanliness, its temperature, and its humidity, in order that it may give to the air inside, a "something" which "manufactured air" has so far failed to supply.

Air conditioning will progress faster with a proper public appreciation of each of its phases. It is not a fad to be built solely on the hope of immediate sales, but a new industry which, if built on solid ground, will grow rapidly and will surely endure.



A self-contained and portable air-conditioning and condensing unit in a single small cabinet



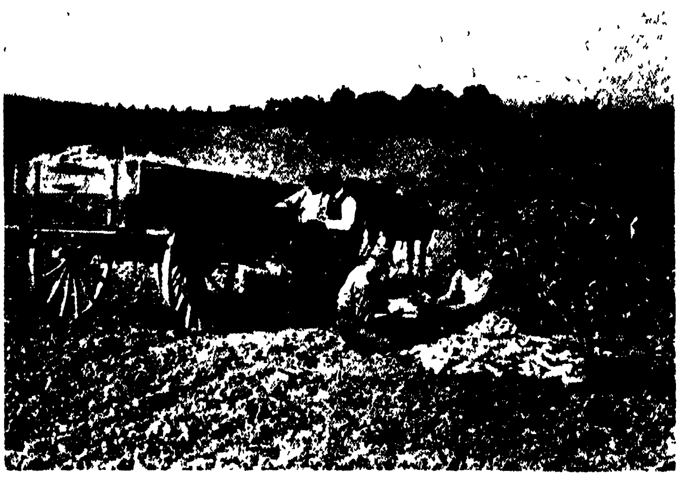
A composite comfort curve, based on conditions in an average home, but subject to the varying limitations discussed in the text of the accompanying article

INDUSTRIAL CORN

By PHILIP H. SMITH

CORN, our major agricultural crop, moves steadily toward industrialization. Ever since chemists found the way to break down the kernel into its components, the golden grain has been playing an increasingly important rôle away from the farm. Today, about two million tons undergo factory treatment. The products derived from it are used in more than thirty industries and further penetration is by no means remote.

The refining of corn yields both edible and industrial products, all rather closely allied. The public knows only a few—corn starch, table syrup and cooking oil—but inedible products figure just as prominently in everyday use. The dextrins and starches, of which there are a great variety, permeate industry more thoroughly than the edible products, though they account for a smaller tonnage.



New avenues of use for corn products are being opened up by systematic research in more than thirty industries

THE process used in refining corn is largely mechanical, but surprisingly complete. The complexities are principally in the matter of controls to insure a maximum yield of desired products. If the meat packer can claim distinction for utilizing everything but the squeal in the processing of a pig, the corn refiner, too, has his claim, for when he has put corn through its paces he returns 26 percent of the original grain to the farmer to provide a supplementary feed for his livestock.

The corn kernel has three main parts, the endosperm containing starch, gluten, and solubles; the hull which is chiefly cellulose; and the germ which yields oil and fibrous material. The refiner begins by softening the grain in water and pulling it apart. The hull is shredded, the endosperm broken up, and the germ left intact to float off. From this germ comes an oil used by soap manufacturers, producers of artificial leather, makers of lacquers, varnishes, and photographic film. Refining the oil makes it edible and it reaches the market as a cooking and salad oil.

With the germ removed and some of the solubles recovered from the water of separation, the refining process treats the disintegrated kernel to free it of all substances and leave starch and gluten. These are separated by means of a settling process. Gluten so obtained is used to provide the protein element in stock feed while the starch is held for further treatment.

Starch is the "Mother Lode" of the grain. It gave rise to the refining industry and still remains the principal product in the sense that it is the base component. From raw starch are derived the food starches, the pearl, thin-boiling, crystal, powdered, and lump starches; the gums and dextrins; and finally the sugars and syrups. Gums and dextrins are products of conversion. They are made by treating starch with dilute acid and then neutralizing the acid when the chemical change has progressed to a specified point. The time factor in conversion determines the type of dextrin produced and there are many types, each developed for a specified use in industry.

AS a food, corn starch is too well known to need comment. The other starches, together with the dextrins and gums, play an essential but less well-known part in modern life. When they are shipped from the refiners they may turn up as a constituent of adhesives, explosives, foundry cores, asbestos products, cordage, cosmetics, colors, fireworks, or oil cloth. Starch makes an excellent "finisher," hence it goes to laundries, to the makers of textiles who use it to give the proper texture to their goods, and to the producers of paper who use it for sizing.

To convert starch into sugars and syrups the refiner uses hydrochloric acid just as the human body does. He heats starch in the presence of this acid and by varying the time, pressure, and temperature controls he can produce any of several sugars and syrups. Completely converted starch makes dextrose or "grape sugar," so-called because it occurs normally in fruits and vegetables. This sugar is identical in chemical nature with the sugar found in the human system and is unique in that it can be assimilated by the body without change, whereas ordinary sugars (sucrose) must be converted into dextrose before assimilation. Crude corn sugar has several industrial uses. The most striking one is in the manufacture of rayon, where it improves the quality of the textile. Refined dextrose and syrups are used in foods, principally as a sweetening agent in ice cream, candy, and bakery products.

AFTER noting the array of derivatives and their wide application in industry it seems justifiable to term corn an industrial product. On the other hand, relating the volume of corn refined to the volume of corn grown makes the word "industrial" almost a misnomer. The corn crop of the United States averages about 2,700,000,000 bushels and of this huge volume only 75,000,000 bushels, or a little less than 3 percent is refined. Such figures as these prove that corn is still overwhelmingly a food crop almost untouched by industry. The real significance—that corn now sides with industry—comes from interpretation of other figures.

If farm consumption and direct food uses of corn were on the increase, it would be far-fetched to stress the importance of industrial use (employing the word industrial to embrace food use after factory treatment). But the corn crop has long held at 2,700,000,000 bushels and consumption on a per capita basis has been declining for 30 years. It is a fact that the crop volume of 1902 would be adequate for today's population. Added to this decline in direct use there is a falling off in potential demand because our people have

changed their dietary habits. The public has been cutting down on meat eating and this presages a stationary if not reduced demand for corn-fed hogs and cattle which now consume 50 percent of all corn raised. Corn has failed utterly to keep pace with population growth and the slowing down of this growth, already manifested, holds no promise for an expanding market.

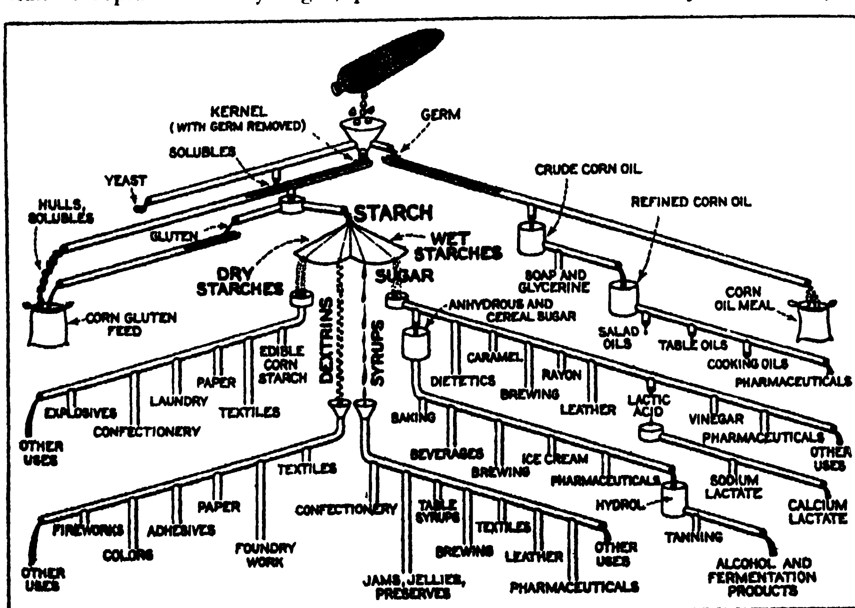
THIS situation places the industrial use of corn in a new light. It focuses attention upon corn derivatives even though an increase in their use may be slow or slight. This is so because corn used for refining is bought for cash and at present represents one third of the entire cash market. Economists may disagree as to the measure of influence on corn prices wielded by this cash market, since the price of corn-fed livestock bears heavily upon it, but they all agree that it is a factor with which to reckon. An active industrial market, they hold, is desirable for the maintenance of equilibrium between supply and demand. If industrial use expands it may prove a boon all around and there are potentialities for doubling, if not tripling present consumption.

There are possibilities that the chemist will find new uses for starch but the future of corn derivatives in industry does not hinge on remote contingencies. It bases upon a more widespread use of corn sugar or dextrose. The potentialities of this market have grown ever since the chemist found a way to make dextrose pure, and it was given a boost recently by a Federal ruling which permits the use of dextrose in certain foods without so labeling.

This lifting of the ban on dextrose opened a new market but it did not mean an overnight penetration of that market, for dextrose cannot in all instances replace ordinary sugar, pound for pound. Dextrose is only three fourths as sweet as ordinary cane or beet sugar, a quality which limits its use in some directions and enhances its value in others. When used in the canning of fruit, for example, exact formulas must be developed to make the product superior and that takes both time and experience. This brings the technician to the fore, but it doesn't replace the chemist. The food chemist is working upon matters more fundamental upon which to raise the structure of a larger market. He is delving into the nature of dextrose.

Dextrose may have very definite nutritional and physiological advantages in the general diet. A hint of this is given in the recommended feeding of syrups to infants in the scientific belief that the dextrose and edible dextrine content has merit. But more needs to be known about dextrose and its place in the human diet and this unknown is now being investigated in several of the large universities where manufacturer sponsored researches are being conducted under the broad direction of the Corn Industries Research Foundation.

THE expansion of the use of corn derivatives, however, does not wait wholly on research. Experience in the handling of dextrose in several industries has been of sufficient duration to prove practicability and to warrant broader use immediately. Candy manufacturers have discovered that ordinary sugar can be replaced with dextrose to the extent of 40 percent with improvement in the consistency and flavor of the product. Bakers now use dextrose and could use more generally; makers of jams, jellies, and canned fruit can work out formulas combining dextrose with cane sugar in varying amounts to get maximum benefit. In the production of ice cream about 20 percent of sugar



Flow sheet showing some of the varying uses to which corn products are put

Corn starch and gluten are here passed through fine mesh silk to remove fiber and other particles

requirements can be met advantageously with dextrose, while a 50-50 blend of cane sugar and dextrose is considered meritorious in condensed milk.

Certain types of foods can be prepared with corn syrups even better than with dextrose. This syrup contains carbohydrates, dextrose, maltose, and dextrine and has a decided place in food preparation, as it prevents crystallization which occurs with cane sugar.

If it is the food industries which offer the greatest possibilities for the immediate growth in use of corn, it is food again which gives promise for the future. Ultimately dextrose may have a large household use. While it is less sweet than ordinary sugar it has its place, and household economists are busy finding it. And there is an almost untouched market in the manufacture of soft drinks, now opened with the discovery that carbonated beverages can be given a better body and more natural flavor when dextrose is used.

NO statement of the industrialization of corn would be complete without mention of commercial alcohol. At present only about 27,000,000 bushels are used for alcohol manufacture since imported blackstrap molasses is now the main source and a cheaper one.

But "ifs" and "whens" have little place in discussing the probabilities of further industrialization of corn. There is future enough without figuring what might take place if tariffs were wholly favorable or the petroleum industry opened its arms to corn-made alcohol. If corn dextrose should be used by the food industries only to the extent that it would make superior foods in the light of existing knowledge, some 75,000,000 more bushels, some 2,000,000 more tons of corn, would flow to factories for refining. This in itself is a goal of no mean proportion and sufficient to keep activities at a high pitch for many years to come.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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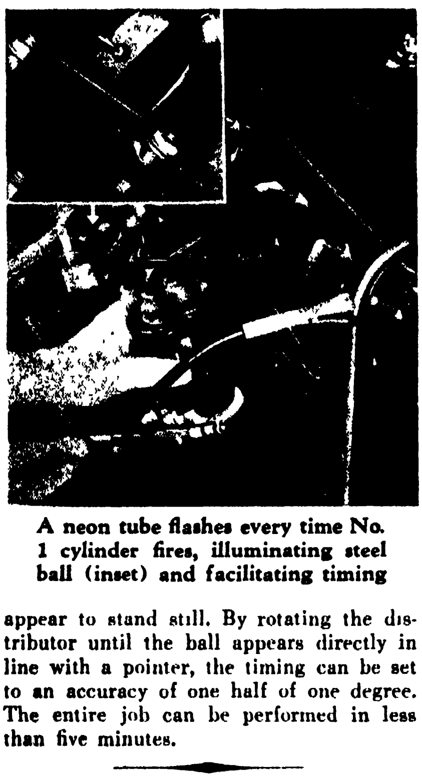
A. E. BUCHANAN, Jr.
Lehigh University

Timing Ignition While Engine is Idling

A SMALL neon lamp, flashing each time the spark plug of number one cylinder fires, and illuminating a polished steel ball set in the rim of the flywheel, facilitates the timing of the 1934 Chevrolet engine. The flashing of the lamp makes the ball appear to stand still. By rotating the distributor until the ball appears directly in line with a pointer, the timing can be set to an accuracy of one half of one degree. The entire job can be performed in less than five minutes.



A neon tube flashes every time No. 1 cylinder fires, illuminating steel ball (inset) and facilitating timing

Radio Does Not Cause Drought

WHAT is the effect of radio broadcasting upon weather and its responsibility for drought conditions? None, positively none whatever, in the opinion of Charles D. Reed, Director of the State Weather and Crop Bureau of Iowa.

Someone conceived the notion that broadcasting is to blame for the recent drought and resulting dust storms in that section of the Western agricultural area. The notion spread and became popularized, so that the state weather bureau became the target for many letters asking the scientific details on the supposed phenomenon.

Nearly 20 years before radio was thought of, in 1886, occurred in Iowa the driest summer of 61 years with an average rainfall in June, July, and August of only 4.25 inches. Crop failure was almost complete in Iowa in 1894, when only 4.88 inches of rain fell; the corn yield was only 12 bushels to the acre.—*The United States News.*

Waterproof Non-Glossy Wallpaper

MANUFACTURERS of wallpaper have for many years worked on the idea of developing a wallpaper which would have the softness of ordinary wallpaper and yet would be sufficiently waterproof as to be washable. Some papers have been rendered waterproof by the addition of various kinds of varnish coatings but these are too glossy to be desirable. By the use of well-known chemicals and by a process which has long been available and needed but slight development in order to adapt it to the manufacture of waterproof wallpaper, the Imperial Paper and Color Corporation has now solved this problem satisfactorily. This company produces a paper which does not differ in appearance from the ordinary paper but is completely waterproof—so much so that test samples have been washed as many as 300 times without appreciable damage to the surface or colors.

In the manufacture of this new paper a sizing material such as casein, animal glue, or albumin is incorporated in the material with which the web of paper or similar material is coated. After the application of such coating material to the web, an agent such as formaldehyde or metallic salts or a mixture of such metallic salts, capable of converting the sizing material into a form substantially insoluble in water, is applied to the coating.

In practicing the process, the web of paper is first coated on one side with clay and a solubilized casein. If a colored or tinted coating is desired, a suitable pigment may be added to the coating material The coating is then dried and the desired figures or designs are printed with a composition comprising the solubilized casein, pigments, clay, and the like. After the printing has been done, but before it is dried, the formaldehyde solution is sprayed on the surface and the coating and printing are dried.

Working Model of Turbine

A WORKING model of the largest industrial turbine-generator ever built, which has been presented to Henry Ford by the General Electric Company, builder of the original machine, will constitute a feature of the Ford Motor Company's ex-

Working model of the world's largest turbine

hibit at A Century of Progress this summer.

The model is 1/16th the linear size of the 110,000-kilowatt vertical compound turbine generator built at Schenectady in 1930 and now installed at the Ford Rouge plant, Detroit. It is complete in every detail, even to the turbine blades, and a cutaway section shows how it operates. The model is the work of H. E. Chesbro, whose scaled-down reproduction of an electric ship was on display at A Century of Progress last year.

Plastic Cream

THICK cream made from milk—this is the latest development of the dairy industry, "plastic cream." It is made by whizzing the very "daylights" out of surplus milk in a very high-speed centrifugal machine at a higher temperature than customary in the ordinary cream separator, according to M. J. Mack and C. R. Foskett in a recent issue of *Food Industries.* The high centrifugal force thus applied produces a cream testing as much as 80 percent fat.

The milk or cream is pasteurized at 145 degrees, Fahrenheit, with a 30-minute holding period before separation. The cream flows from the separator as a viscous fluid. In a few seconds it is cooled, commercially, to 50 degrees, Fahrenheit, over especially constructed drum coolers. The product, when cooled to this low temperature, becomes plastic and is carried away by a sterilized belt to be packaged. At the present time plain plastic cream generally is packed in 60-pound butter tubs lined with sterilized parchment-paper liners. The cream is removed from the tub as easily as butter and without loss.

Since the introduction of plastic cream, it has been sold chiefly to dairy and ice-cream companies in New York, Philadelphia, Chicago, and throughout New England. It has been used commercially in butter, dairy spreads and ice cream, and has been separated from surplus milk on the farm for home or local consumption. When plastic cream is made into butter, the cost of manufacture is reduced because the churning process is unnecessary. After the fat is solidified by cooling, the plastic cream resembles an unfinished butter. Only working is necessary to convert the solidified cream into butter.

Although plastic cream has been available for only a few months, it is already used regularly by many ice-cream plants to good advantage as a source of butter fat. Plastic cream also makes a very desirable spread, either alone or combined with honey or some similar food product, but at present has a limited use for this purpose. Bakers, confectioners, and other food manufacturers who now use butter might well experiment with plastic cream.—*A. E. B.*

C. Francis Jenkins

ON June 6, 1934, there passed away an inventor whose name is indelibly inscribed in the history of radio and motion pictures. At the age of 66, C. Francis Jenkins died at his home in Washington, D. C. Dr. Jenkins had been in ill health for more than

C. Francis Jenkins

three years but had nevertheless carried on experimental work in his laboratories throughout his illness. The last work which he was attempting to complete had to do with a home movie and sound-recording camera.

Among the honors which had been showered upon Dr. Jenkins in the last few years of his life were the John Scott and Elliott Cresson gold medals of the Franklin Institute.

Dr. Jenkins was one of the pioneers in motion picture work, having projected such a picture before an audience of friends in 1892. He was widely known for his development work in television and facsimile, many records of his progress being published in past issues of SCIENTIFIC AMERICAN. More than 400 inventions are credited to the ingenuity of Dr. Jenkins. His work also touched on the field of aviation in which he developed a sonic altimeter and a control board instrument used in connection with the aviation radio beacon.

Readers who desire to refresh their memories regarding the work of Dr. Jenkins will find interesting material in the following issues of SCIENTIFIC AMERICAN: June 1927, August 1927, August 1928, June 1929, December 1929, and July 1931.

Chemistry Glorifies The Pumpkin

JACK-o'-Lantern is becoming a more useful citizen, according to Dr. Erich Tschermak, of Austria, who has developed the culture of a creeping, rindless pumpkin, containing a nutritious, palatable oil. Whereas we usually regard the lowly pumpkin as raw material for Thanksgiving pies, the chemist is attempting to use it as the basis of a number of useful products, each part of the gourd serving a distinct purpose. The oil from the new type pumpkin may possibly be used in part as a substitute for olive oil in canning sardines and in conserves. The seeds may be utilized in place of almonds. The oil cake serves as a feedstuff for cattle.—*A. E. B.*

New Electric Pyrographic Pen

ONE of the most interesting attractions at fairs used to be the booth of the man who burned designs or your name on leather goods and novelties to be used as souvenirs. The sort of work he did may now be done at home by the use of a new electrical pyrographic pen, neatly made and well-balanced to allow free movement of the hand in burning designs or drawings on such articles as cigarette boxes, waste baskets, and the like.

This new device, called the Pyrolectric Pen, has a highly polished point containing a heating element, a flexible wire for making connection with any lamp socket or

Photographs courtesy The Crosley Radio Corporation

A new angle on air conditioning, which gives promise of great possibilities for future development, is illustrated above. Here the advantages of air conditioning are brought to a localized spot—to the bed, instead of cooling a whole bedroom, which is expensive. The Coolrest cools and dehumidifies a sleeping compartment to be used with any bed

outlet in the house circuit, and a self-contained screw socket for inserting a light bulb in series with the heating element in order to protect the latter.

More Aluminum Uses

THE accompanying photographs illustrate three interesting new uses of aluminum.

An effective example of modern metal work is seen in the ornamental aluminum

doors shown here which were cast at the Fairfield, Connecticut, works of Aluminum Company of America. Each of the four sections contains four figured panels surrounded by intricately interlaced ornaments. After casting, the ornamentation was hand chased, following which the doors were polished to a fine satin finish and high-lights were buffed to a brilliant luster.

Aluminum closures are finding many uses in the recently revived wine and liquor industry. The bottle in the foreground in one of our photographs is capped with a "pilfer-proof" aluminum seal. The bottle at the left illustrates how the upper portion of this closure breaks away from the lower locking ring when the cap is removed, forming an effective safeguard against tampering. The tall wine bottle at the right is capped with an "Aluvin" capsule made of aluminum foil. The capsule, which is available in a variety of colors, is crimped tightly over the top of the bottle by machine. The use of a special adhesive makes possible a firm bond between the foil and bottle, making it practically impossible to remove the capsule without leaving evidence.

The nails are aluminum markers used on poles. The fact that aluminum does not rust and the characters on the markers retain their legibility, makes the metal particularly well suited for this use.

Cheap Aniline by Catalysis

WHILE the modern organic chemist seems to be able to start with almost any compound and juggle it around through a series of chemical changes until he finishes up with what he wants, there is always the question of whether or not the process will pay commercially. Thus, the announcement that aniline can be made from phenol is not news, for chemists have done it in laboratories for years. But the announcement from Germany that a process of converting phenol to aniline by a simple catalytic synthesis in one step is significant because it indicates that a commercially feasible and economical process of producing cheap aniline is "just around the corner."

Professor Franz Fischer is the chemist who has worked out the process, reported in a recent issue of *Chemical and Metallurgical Engineering.* He has condensed phenol and ammonia directly to aniline, at a pressure of 10 atmospheres, with a yield of 10 percent in the presence of catalysts which split off the water, particularly aluminum oxide. The reaction takes place in the vapor phase at 450 to 480 degrees, Centigrade.

Of the catalysts examined aluminum oxide has the best effect. The catalyst lost its action comparatively rapidly, but could

Three new uses for aluminum. *Upper left:* Ornamental doors of intricately ornamented metal. *Above:* Bottle closures. *Right:* Non-rusting markers used on telephone poles

be regenerated by oxidation in air of 450 to 500 degrees, Centigrade. By the use of low pressures, from 5 to 10 atmospheres, the resulting yield was considerably increased. A pressure of about 10 atmospheres (the vapor pressure of ammonia at room temperature) is the most favorable working pressure.—*A. E. B.*

Mother's Milk Still Best

MOTHER'S milk is the means to further reduction of the death rate among American babies, Drs. Clifford Grulee, Hayworth N. Sanford, and Paul H. Herron of Chicago recently told members of the American Medical Association. They based this opinion on a study of 20,000 Chicago babies.

The mortality for these infants was ten times higher among those artificially fed than among those fed by their mothers in the natural manner, the baby specialists found.

The success of artificial feeding of infants during the past few years has made it seem that the prepared baby foods can safely replace mother's milk, but there is no scientific proof of this, Dr. Grulee and associates declared.

Natural feeding by the mother gave greater resistance to infection than artificial feeding, the records of the 20,000 babies showed. Even partial breast feeding gave considerable protection against disease which the completely artificially fed babies did not enjoy.—*Science Service.*

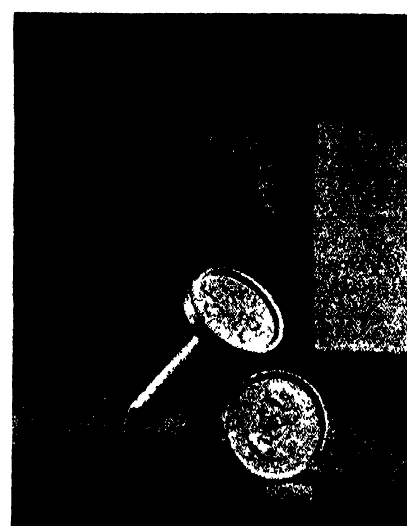
It is not as widely known as it should be that, despite the well recognized value of artificial feeding for babies, mother's milk is incomparably superior. Statistics prove this.—EDITOR.

Rain Will Interfere with Ultra-Short-Wave Radio

FOG and rain will prevent man from developing a reliable wartime or commercial radio communication system with ultra-short waves less than ten centimeters long, Prof. Gennady W. Potapenko, California Institute of Technology physicist, predicts.

Short waves of this length or less can be transmitted in clear weather, he said. However, their absorption during inclement weather makes them unreliable for commercial purposes. Based on data compiled on charts, Prof. Potapenko made the forecast that rain and fog would absorb all waves from ten centimeters to the infra-red waves of about 100 microns in length.

"Therefore," he said, "in order to avoid



atmosphere absorption by fog and rain, one must use waves either longer than ten centimeters, or shorter than 100 microns." The advantage of ultra-short-wave communications, Prof. Potapenko stated, lies in the fact that messages can be concentrated in a beam.—*Science Service.*

Psychic Medium Fails

IF there is a mysterious "force" which manifests itself when a medium goes into a trance, it has eluded the keen eye of the infra-red camera.

To test the psychic powers of Rudi Schneider, well-known medium, two British investigators have made a series of experiments using an infra-red beam and also a camera with a movie film sensitive to infra-red. The camera thus equipped is capable

of taking pictures in feeble red light or even in the absence of visible light, thus working in conditions of light that mediums usually prefer for their sittings.

Preliminary announcement of their findings is made to the British scientific journal *Nature* by the investigators, Theodore Besterman and Oliver Gatty of the Society for Psychical Research, London.

The infra-red film caught nothing unusual except the moving of a curtain.

When a beam of infra-red light was used in connection with apparatus in the tests, there were frequent announcements by the trance personality that the "force" had entered the ray. Notwithstanding this, the two investigators could obtain no evidence of absorption of the beam of infra-red light.

While in a trance, the medium on several occasions announced that the "force" had gone into one of a pair of cotton-wool lagged boxes and remained there for some 15 minutes, but no change in temperature of the box could be detected.

During half an hour, the "force" could produce no significant difference in rate of growth of two strains of bacilli or of dormant yeast.

The investigators spoke highly of Mr. Schneider's willingness to submit to tests and control.—*Science Service.*

Animal Fat For Feeding Calves

A NEW outlet for animal fat has been developed, which will afford farmers a better way to utilize skim milk on the farm. The idea is to feed the fat to calves as a milk supplement in the form of a homogenized product called "Vita-Fat." Thus the farmer may skim the butter fat from his milk, replace it by other animal fats of cheaper cost and value, and feed it to produce better calves than before. The "Vita-Fat" contains 55 percent of fat and adequate quantities of vitamins A and B. —*A. E. B.*

Transoceanic Plane Refueling Stations

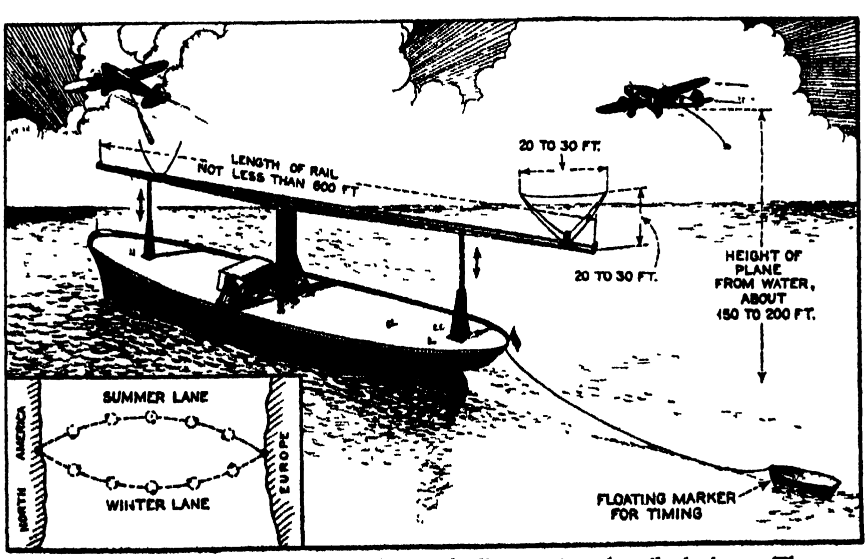
IF we grant that transoceanic airplane service for freight or passengers is desirable—and apparently it is, if the interest in the subject by large transport operators may be taken as a criterion—then the question becomes one of "ground" equipment rather than of planes. Present-day planes and motors have been developed to a point where transatlantic flights in a single hop are entirely possible, but impractical because little or no payload can be carried. The huge amount of fuel and oil required for the long flight prohibits carrying freight or passengers.

The problem, apparently, requires refueling at sea so that planes can carry a minimum of gasoline and a maximum of payload. One highly interesting proposal, which involves refueling in flight at sea without the use of refueling planes, calls for a series of specially equipped liners placed at intervals along a transoceanic air lane.

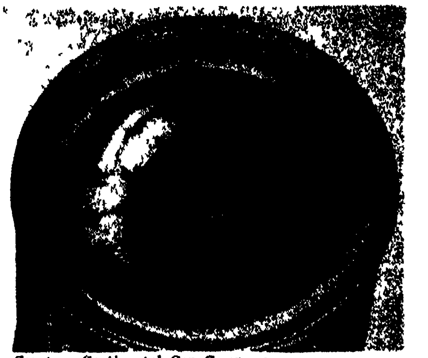
These liners, which will be comparatively low in cost and maintenance because of their specialized work, will be provided with a long catapult running lengthwise of the ship, and pivoted at the center. Cars running on the track of this catapult, as shown in the drawing herewith, will carry tanks of fuel and oil which will be picked up by the planes in flight by means of a trailing cable and hook. Acceleration of the car just prior to picking up the load will reduce to a minimum the strain on the plane. Experiments in the past have proved that picking up weights in this manner is perfectly feasible.

In practice, the system should work as follows: The pivoted beam is provided at or near each end with a hydraulic or other means for keeping the track close to the horizontal regardless of pitching. This will be accomplished by means of automatic mercury or pendulum switches. Heaving of the ship is comparatively slow and it is assumed that it can be allowed for by the pilot.

When a plane approaches to refuel, the liner is headed into the wind. The pilot of the plane maneuvers into position at the lowest practicable flying speed and heads straight along the catapult track. As he passes over a marker towed by the ship, the catapult car is started so that by the time the hook engages with the loop attached to the fuel tank, the car will be going at maximum speed. The plane flies on, the



Drawing of the transoceanic airplane refueling station described above. These stations may be located in positions most advantageous according to weather


Courtesy Continental Can Company

"Window-top" cans permit the purchaser to see the exact condition of contents before buying. The "window" is of heat-resisting Pyrex sealed in before the can is packed

fuel tank being drawn up by a winch, and an empty tank dropped, to be picked up at leisure by the liner.

This short description gives a bare outline of an interesting project; mechanical details are many and will require much work, but do not appear to be insurmountable. The system will be perfectly flexible and with an adequate radio communication system should be able to forestall much of the weather delays that must always be considered. The positions of the ships may be changed for winter and summer routes, just as in the case of steamer lines, so that seasonal storm areas may be avoided.

The big feature of this system, from the pilot's point of view, is that it eliminates the necessity of frequent landing and take-off—always the danger points with heavily loaded planes.

Air Trains

THE Russians are intensely interested in gliders and have quite recently made a number of splendid records. One glider pilot at a meet in the Crimea recently achieved the record altitude of 10,827 feet. Another flew 38 miles in a straight line and returned to his starting point. These feats sound a little like perpetual motion, but are evidently feasible by men who know how to take advantage of rising currents, cloud and thermal effects.

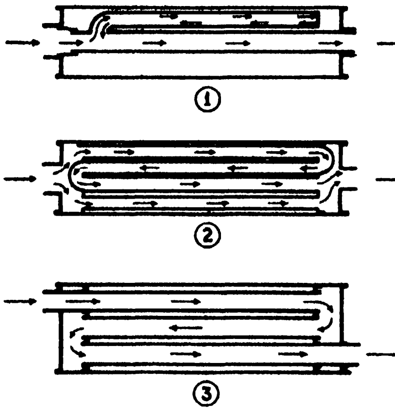
Of course, no one believes, in spite of these remarkable records, that the glider will ever become an instrument of transportation, but the Russians are making experiments which may possibly lead to practical results. Thus for the first time in the history of the art an airplane picked up a glider weighing 625 pounds, at Samara. The glider was picked up by an automatic coupling device by a plane flying at 75 miles per hour and sailed into the air after a run of 60 yards on the ground. Our readers will remember that Captain Frank M. Hawks made a transcontinental flight towing a glider, but the Soviet pilots have gone one step further. One Fedosief actually pulled an "air train" of three gliders for 25 miles, after which the glider pilots disconnected their own crafts and glided safely to the ground.

If picking up and releasing gliders becomes a matter of current practice, then we can see a number of applications in airmail work, possibly in refueling and so on. Of course, the problem of stability and

control in such an air train becomes a matter for intensive study and experiment. Also, no air train is likely to be as efficient as a single airplane, because of interference, drag of cables, and so forth.—*A. K.*

Cancelling Sound Waves

AT a recent meeting of the Society of Automotive Engineers, E. G. Gunn discussed the interesting process of cancelling sound waves due to engine exhaust—a process which is equally adaptable to the aircraft and the automobile engine. Physicists have long been familiar with this process of sound cancellation. It is the engineers, however, who are developing mufflers dependent on sound wave interference or cancellation. These mufflers are of three general types.



Three methods of cancelling sound waves in mufflers, described here

Figure 1 shows a Quincke unit. It embodies a closed-in tube of a length equal to one fourth the wavelength to be cancelled. The wave enters the tube, is reflected from the far end, and returns 180 degrees out of phase, thus completely or partially cancelling the incoming sound wave.

A second method incorporates the so-called Herschell tubes. (Figure 2.) Here a divided path is provided for the sound waves. One path is longer than the short path by one half of the wavelength to be cancelled. The waves, on re-uniting at the exit end of the silencer, are one half wavelength out of phase and cancel.

Still another dodge is shown in Figure 3. Here the gas travels through perforated pipes alternately from the one end of the muffler to the other. These are usually made with three pipes, the gas first flowing from the front to the rear through one pipe, then through another pipe to the front, and then to the rear and into the tail pipe. Since at any transverse section of the muffler a wave in one pipe is out of phase with the wave in another pipe, it can short circuit across the surrounding chamber and the waves cancel.

People often inquire why silencers are not more frequently used on the airplane. This is because airplane mufflers have been of the baffle type in which the gas went through holes into an expansion chamber, thence through holes into another chamber. Such restrictions offer more resistance to the flow of exhaust gas than to the passage of sound. Consequently to get a fair degree of silencing, considerable back pressure is developed. The aircraft operator cannot and will not tolerate this back pressure.

With the new type of "sound-wave cancellation" mufflers, which give little or no back pressure, the prospects of silencing the exhaust of an airplane become much more promising.—*A. K.*

Langley Field

THE writer recently had the privilege of attending the annual conference of the National Advisory Committee for Aeronautics at Langley Field, Virginia. The research work of the Committee is both extensive and comprehensive, so that only a very brief review of the Conference is possible in these columns.

It has often been stated that the problem of getting sufficient air to flow past the cylinders would put a limit to the size and power of the air-cooled aircraft engine. Perhaps the introduction of a blower forcing the air into an enclosure completely surrounding the cylinder will put this limit indefinitely far off. At any rate, such experiments have been made, and the cylinders have been kept perfectly cool with only 4 percent of the engine power being used up by the blower.

A new safety fuel, developed by the Standard Oil of New Jersey, attracted considerable attention. This is heavier than gasoline, and has a higher flash point so that fire hazard is diminished. At the same time it has wonderful anti-knock properties and can be employed at a compression ratio of 9½ to 1, instead of the usual 6 to 1 for gasoline, without detonation. Hence the "Safety Fuel" gives at least equal power and economy, and surpasses gasoline in safety. Such a development may have considerable importance in aviation operations.

On the aerodynamic side of things, we were particularly impressed with the small six-inch high-speed wind tunnel, in which small airfoils can be tested at speeds of 400 to 600 miles per hour. At very high speeds, approaching the speed of sound, the ordinary airfoil loses both lift and efficiency. The usual streamline flow ceases and compression waves are set up, just as in the case of a rapidly moving bullet. It has now been definitely shown that in propeller blades (which turn exceedingly fast) this compressibility effect can be diminished by using a sharp entering edge for the blade instead of the conventional rounded edge of the airplane wing. In stratosphere flying at very high speeds (which may come sooner than we now think) the same re-design of the airfoil may be necessary to avoid this detrimental compressibility effect. Hence the new high-speed research has more than academic importance.

Visitors at the Conference were given a ride on the carriage of the huge 2200-foot long towing basin, the largest in the world. Under this carriage the flying boat hull or the seaplane float is attached, and the resistance of the float is automatically measured; at the same time the spray can be observed. Thus many factors entering into the problem of hull and float design are being systematically investigated. The towing carriage is capable of a top speed of 56 miles per hour, but the visitors were only treated to 25 miles an hour. Even with this long channel, it appears that at the high speed the approach of the end wall is so rapid as to be terrifying to the uninitiated!

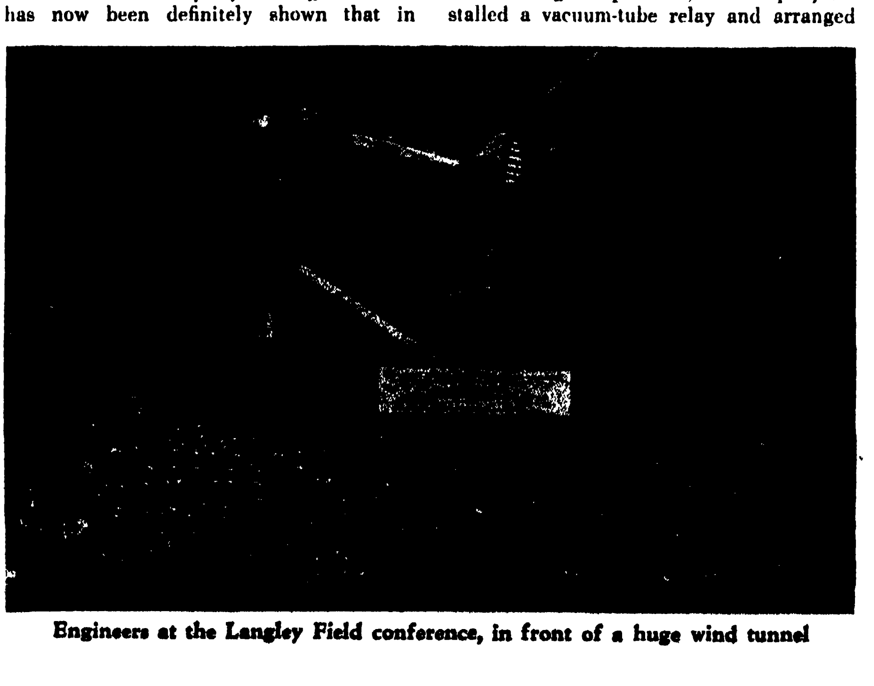
Lift increase devices, and rotary wing airfoils were among other interesting matters exhibited to and discussed by the visiting constructors and engineers.—*A. K.*

Stick—Stuck

THE manufacturers were stuck because the glue did not stick. But they stuck a vacuum tube into the sticking process, and no longer are they stuck by not having the product stick.

All of which is merely introduction to a story of a vacuum-tube application. A company in San Francisco manufactures box ends from scrap lumber. In the process, after the lumber has been grooved, certain pieces are glued and then pressed together. At one time it was practically impossible to detect the absence of glue in the grooves and the company found that box ends made by pressing these grooved pieces together pulled apart through lack of glue. This was both expensive and annoying.

In solving the problem, the company installed a vacuum-tube relay and arranged



Engineers at the Langley Field conference, in front of a huge wind tunnel

steel piano-wire contacts to scrape in the grooves in such a manner that the circuit is completed through the film of glue. This circuit is connected to the grid of an amplifier tube mounted on a panel. This amplifier tube is so connected as to control a sensitive relay. As long as the circuit is closed through the glue, no action occurs, but as soon as the circuit is opened by the absence of glue the relay operates to ring a bell and light a lamp.

A Quick Job with Dynamite

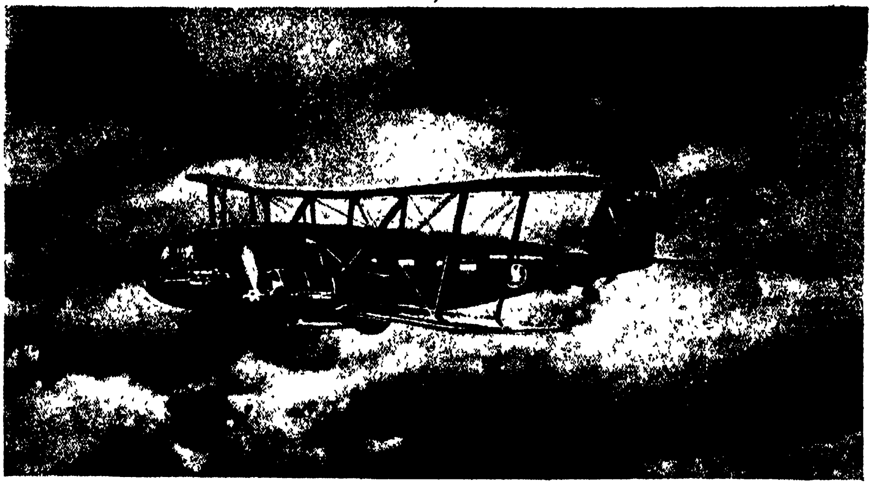
A RATHER unusual use of dynamite as an aid in taking out standing trees is reported from the McComb Subsistence Homestead at McComb, Mississippi, where work is being done under the auspices of the Subsistence Homestead Division of the Department of the Interior. At that place, in order to save time, numbers of rather large standing trees had to be removed. The problem was solved by employing a combination of tractor and dynamite. The smaller growth was pulled out by the tractor. When it came to the larger trees, a long cable was rigged from the tractor to a point as high as possible in the tree to be uprooted. A light charge of dynamite (depending, of course, on the size of the tree) was placed under the roots. When everything was ready, the signal was given, the cable tightened, and the dynamite detonated.

The report indicates that the operation is successful, economical, and time-saving.

Air Sleepers

IT is claimed by American Airways that they are putting into service the world's first sleeper plane in their new Curtiss Condor. This ship has a top speed of 190 miles an hour and a cruising speed of 160 miles an hour. It will carry 12 passengers, two pilots, and a steward. The first sleeper plane has now proved itself entirely satisfactory and five more ships equipped in this fashion will soon be in service on the Dallas, Fort Worth, Los Angeles route.

Photographs reproduced in these columns illustrate the Condor with landing gear retracted, the day accommodations, and the sleeper. The two seats in each compartment are quickly convertible, in flight or on the ground, into spacious lower and upper berths, an inch longer than the standard berths in a Pullman car. Each passenger during the day is provided with an unusually wide lounge-type chair, individual window, reading light, service call button, and so on. Ventilation and noise proofing go without saying. Luggage shelf, clothing net, coat hanger, ash tray, and so forth, are also provided.



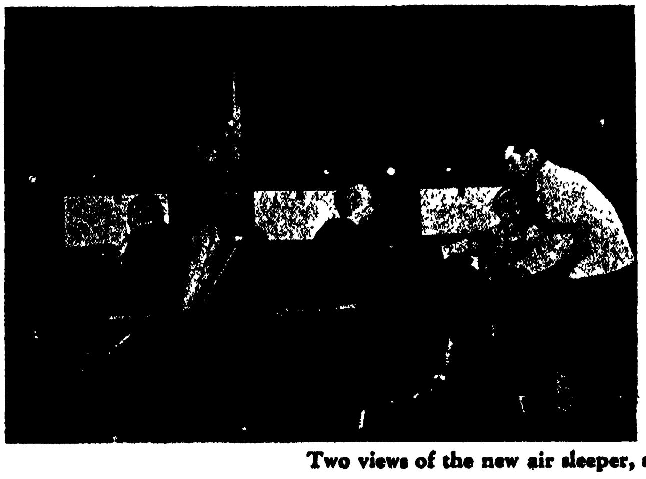
A Curtiss Condor plane with sleeping accommodations

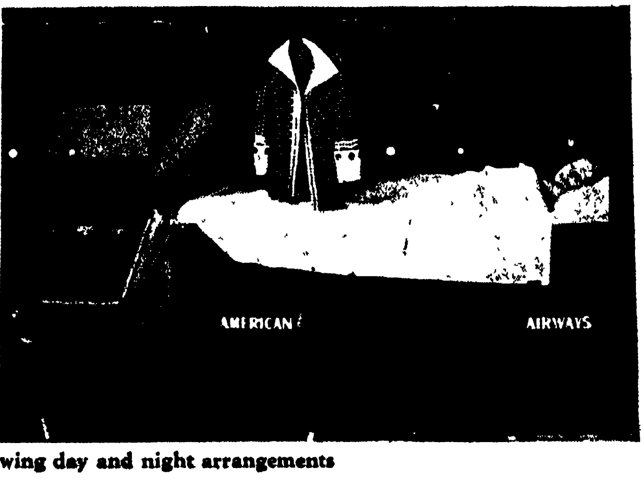
Wm. E. Boeing, awarded the Daniel Guggenheim air pioneering medal

This is a commendable advance in the comfort and adaptability of the modern transport. Only one word of warning should be said. In case of a rapid descent or ascent and a consequent change in pressure, the ears are apt to be slightly affected. This is noticeable even in a rapidly moving elevator in a skyscraper. The effect is not serious and passes off in a very few minutes because the human organism is remarkably adaptable. It does not appear certain, however, that the same power of accommodation is present when the occupant is asleep—or so at least a well-informed airplane operator tells us. Therefore, if sleepers are to be used extensively in the airplane, pilots should be instructed neither to make too rapid ascents to high altitude, nor to make too rapid descents when approaching an airport. Or, alternatively, sleeper passengers should be awakened when a rapid change in altitude and pressure is to be expected.— *A. K.*

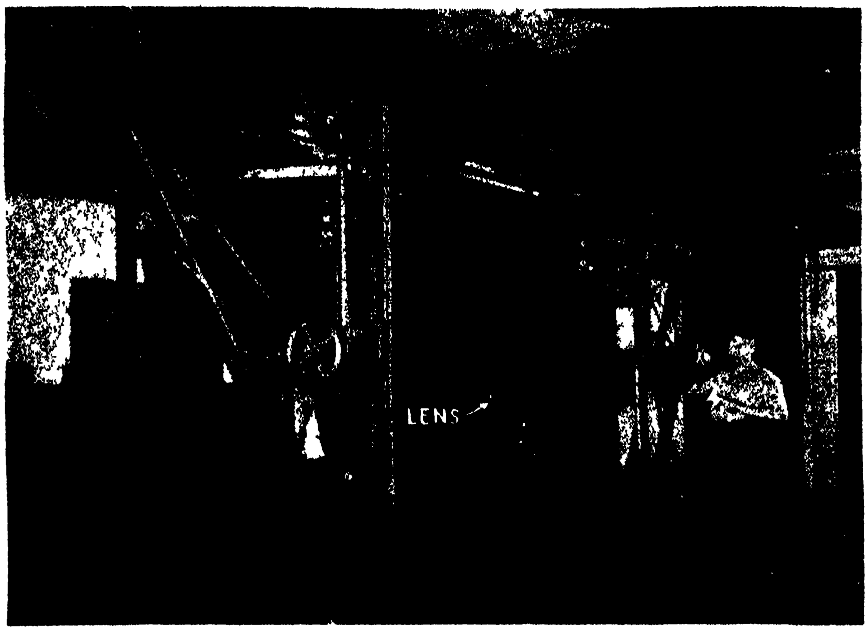
William Edward Boeing

BORN in 1881, educated at Yale, and active at an early age in mining and lumber work, Mr. Boeing learned to fly in 1915. An accident to a seaplane in which he was flying led him to build seaplanes of his own, first in the Pacific Aero Products, and then in the Boeing Airplane Company which has achieved such success in both military and transport aircraft. This year he was awarded the Daniel Guggenheim Medal for successful pioneering in aviation. At the same time, under the new regulations of the Post Office Department, the United Aircraft and Transport has split up into three component parts: Boeing Airplane Company, in the west; United Aircraft in the east; and United Airlines as an independent operating unit. So Mr. Boeing is again left in independent charge of his magnificent plant on the west coast.—*A. K.*





Two views of the new air sleeper, showing day and night arrangements



Looking toward the lens of the giant camera of the Coast and Geodetic Survey

Emotions Cause Physical Disease

AN emotional disturbance may be the cause of such physical diseases as stomach ulcers, goiter, and diabetes. Not merely the symptoms of such ailments, but actual changes in the tissues of various organs and glands may be produced by emotional factors alone.

These facts, showing the close relation between mind and body and personality, were brought out at a meeting of the American Psychiatric Association and were particularly emphasized by the association's presiding officer, Dr. George R. Kirby of New York.

Figures from various big diagnostic clinics show that for about half the patients who come in with complaints of physical disease no sign of such disease can be found by the most careful examination with X rays and all the other aids of modern medical science. Even in animals emotional shock or disturbances can produce physical diseases.

Psychiatrists hope that physicians in the future will not only examine a patient by taking his pulse and blood pressure and by X-ray pictures but will analyze or examine his personality and his emotional make-up as well in order to find the real cause of his ailment and how to treat it. —*Science Service.*

Giant Camera of Coast and Geodetic Survey

THOSE to whom "camera" means a box carried about in the hand may properly be astounded at the mammoth instrument, 31 feet in length and 14 tons in weight, capable of taking a picture 50 by 50 inches in size, now used in reproducing the nation's nautical charts and airway maps. Such a "camera" has just been put to work in the basement of the Commerce Building, Washington, D. C., after two years devoted to its design, construction, adjustment, and calibration, at a total cost of 15,240 dollars.

Captain R. S. Patton, Director of the United States Coast and Geodetic Survey, states that this gigantic instrument will make it possible to photograph a complete chart on one negative—a decided reduction in the cost of chart production.

According to Captain Patton, it represents an increase in the speed and efficiency of chart reproduction, so essential to the safety of navigation. It is capable of reproducing chart drawings with a probable error of only one or two thousandths of an inch —an error so small that the eye can scarcely detect it without a microscope.

The frame of the camera resembles a railroad bridge structure, with its 27-inch "I" beams. It is suspended on three groups of chains, from girders resting directly on the building foundations. These chains permit the camera to swing free from any horizontal building vibrations, while provision has been made for cork pads to damp out vertical vibrations. The three-point support also makes the camera independent of any settling of the foundations.

The plate-holding end is partitioned off to form a darkroom, permitting the massive negatives to be sensitized, exposed, and developed without bothering with plate-holders.

Although each copyboard weighs almost a ton, it can be moved along its track by the pressure of a finger-tip and then set into position to within a thousandth of an inch by a scale fixed to the overhead track, read by an optical vernier in a periscope.

Synthetic Perfumes in United States

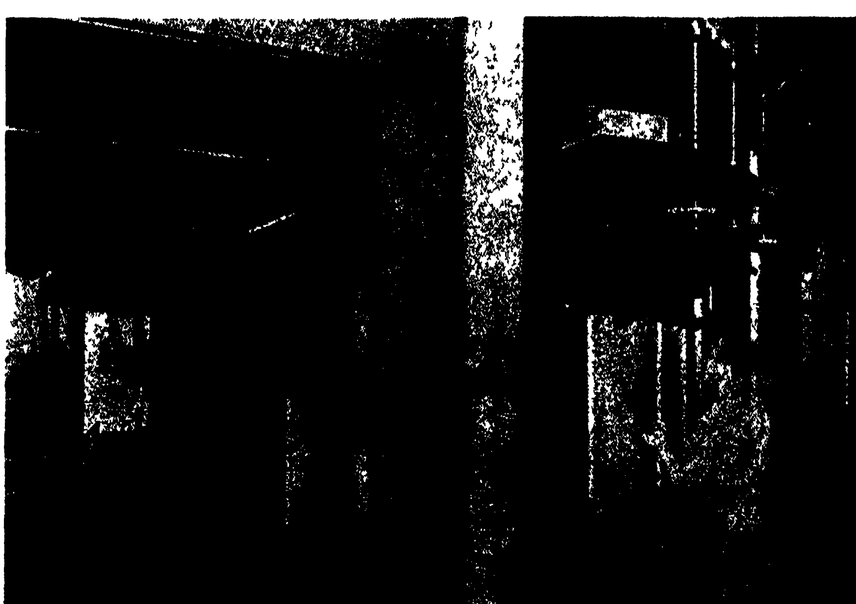
AMERICAN manufacturers continue to make progress in the production of artificial flavors and perfumes, a large proportion of which is composed of synthetic aromatic chemicals produced from coal tar. At the rate progress is being made it may not be long before the United States will be independent of foreign sources for these important commodities, according to the Chemical Division, Bureau of Foreign and Domestic Commerce.

The downward trend in imports of flavors and perfume materials of coal-tar origin, apparent in 1933, is continuing in 1934. During the calendar year 1932 a total of 67,469 pounds was imported; imports declined to 46,000 pounds for 1933. Domestic production of artificial flavor and perfume materials in 1932 totaled 2,300,000 pounds valued at more than 2,625,000 dollars, indicating that less than 3 percent of our needs were obtained abroad.—*A. E. B.*

Pennsylvania Pearls

PERSONS who never have thought of pearls as a Pennsylvania product would have found a pleasant surprise awaiting them in June in the Free Natural History Museum of the Academy of Natural Sciences, in Philadelphia, where a number of such pearls were placed on special exhibition. This collection, the only one of its kind, was made by Frank M. Ebert of Tamaqua, Pennsylvania.

Over a period of 40 years Mr. Ebert carefully fished the small streams near Tamaqua forming the headwaters of the Schuylkill River for the pearl-bearing fresh-water mus-



Arrow points to the copyboard of the giant camera

sel, the scientific name of which is *Margaritana margaritifera*, and this collection represents the fruits of his long search. It contains about 100 specimens, among which are some of choice size, shape, and color, and many seed pearls. Some of the mussel shells are also shown, including one to which a pearl is attached as originally found.

More than a century ago the Moravian settlers in Pennsylvania gathered a few pearls from the Lehigh River near Bethlehem. The year 1857 was the "pearl fever" year. A Paterson, New Jersey, carpenter found a pearl weighing 93 grains in a small tributary of the Passaic River. It was purchased by the Empress Eugenie, and today is known as the "Queen Pearl," though it since has passed into possession of the bejeweled Gaekwar of Baroda. Its value is more than 10,000 dollars.

Moisture and Heat Indicators

TWO highly practical and simple instruments, one for determining moisture in stacks of paper in printing plants and the other for determining the amount of heat accumulating in machine rolls or rolls of materials being produced are shown in use in two accompanying photographs.

The amount of moisture present in paper and the relative humidity conditions of the press-room atmosphere, as well as the relation of one to the other, are important factors in lithography and color printing. The problem of obtaining satisfactory moisture conditions and holding them reasonably uniform has been doubly difficult through lack of a simple, practical means of checking these elusive factors. Thus the Printer's Moisture Indicator has been developed.

This is a small portable instrument designed to measure the moisture content of piled or stacked sheets of paper—also to indicate the moisture in pressroom air. The instrument consists of a light case with a pistol grip, to which is attached a thin hollow blade 1 inch wide by 18 inches long, the extreme end of which is perforated on both sides. Within the perforated section of the blade is located a measuring element, the length of which varies with changes in

A portable temperature indicator that will work on curved surfaces

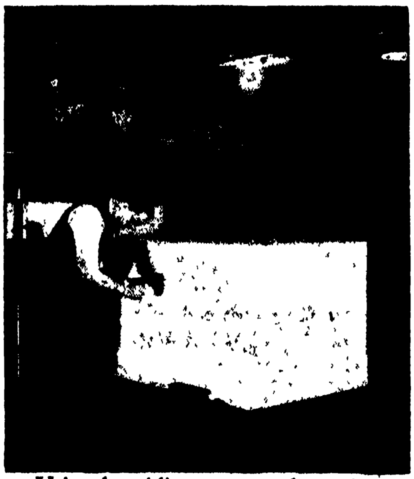
moisture, and the movement of which causes the indicator pointer to move across the scale. The scale is calibrated in percent relative humidity with a range of 20 to 80 percent.

Modern industry has long needed an accurate and rapid means for determining the temperature of flat and curved surfaces. These temperature readings must be obtained under working conditions whether the surfaces are stationary or in motion.

By successive improvements in the construction of the thermo-electric pyrometer, the Cambridge Instrument Company has perfected a series of simple, accurate instruments for quickly and easily measuring the temperature of stationary and moving surfaces, one of which is shown here.

The hand model surface pyrometer is a self-contained instrument for use upon readily accessible moving rolls. A sensitive, thin, flat-strip thermo-couple with the junction at its mid-point is stretched across the end of an inverted bow spring. The latter is fixed to the underside of a metal case enclosing a millivoltmeter and also providing a convenient handle.

In use, the pyrometer is pressed into contact with the heated surface, the thermo-



Using humidity meter to determine moisture content of paper stack

couple strip conforms to the shape of the surface and within five seconds a steady reading of the temperature is obtained. The machine need not be stopped while the temperature is being taken, nor is there any danger of scratching the roll. The Indicator has an easily read scale three inches long, calibrated directly in degrees, Fahrenheit.

Aluminum Chloride Causes Accident

A SERIOUS accident recently occurred in the laboratory of the Department of Chemistry, St. John's University, Collegeville, Minnesota, upon opening a new package of resublimed aluminum chloride. The product was purchased less than six months ago, and was put up in a glass bottle sealed with a rubber stopper. The stopper had barely been moved when it was blown violently to the ceiling and about one-third of the contents (2500 grams) discharged into the eyes and face of the assistant who was opening the bottle, and into the whole room.

It is suspected that the rubber of the stopper was responsible for the decomposition of the aluminum chloride. It is also suggested that the pressure may have been due to absorption of water by the aluminum chloride previous to packing.—*A. E. B.*

Blown Fuse Indicator

WHEN a fuse blows out in a newly designed fuse block, a tiny neon lamp starts to glow immediately and indicates exactly which fuse on a switchboard has

New type of fuse block with "built-in" indicator for blown-out fuses

failed. This little neon lamp is an integral part of the fuse bulb and is automatic in operation. It indicates either loose or blown-out fuses and is distinctly visible, giving an indication which cannot be misinterpreted. The neon lamp will show that there is trouble, whether or not there is load on the circuit.

Fuse blocks with these indicators are available in all standard types and are completely interchangeable with existing equipment.

Birth Control in Tibet

TWO much criticized customs of Tibet, polyandry, or the taking of more than one husband, and the maintenance of a priesthood numbering a third of the male population, are really forms of national birth control, designed to keep the population within the limits of the national food supply, states Dr. Walter N. Koelz, University of Michigan anthropologist, recently returned from a year and a half in that country.

Where the American farmer usually has little more to do than plow and plant a good soil, the Tibetan must start with a poor and stony land, so irregular that he must build terraces and retaining walls to save even that from erosion.

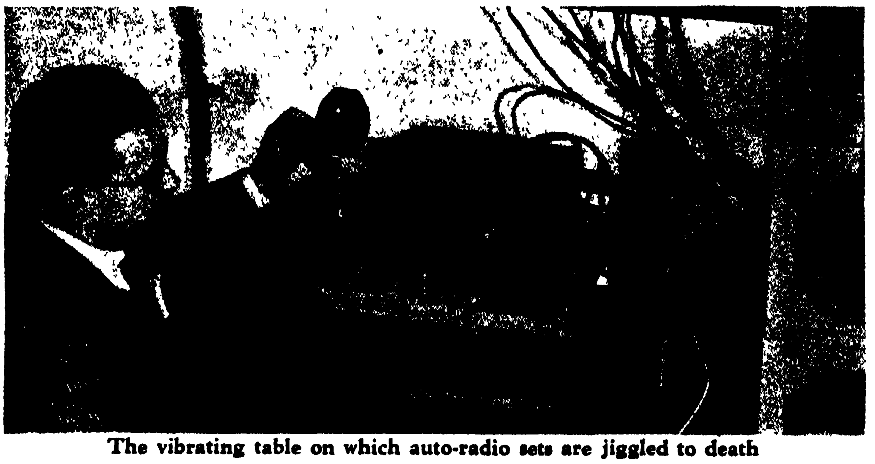
His fields terraced, the Tibetan then faces a very short growing season, liable to late snows and severe early frosts, plus a perpetual summer water shortage. These circumstances have always limited the crops of barley, wheat, buckwheat, and potatoes which may be raised, while lack of good pasturage confines cattle raising to the hardy yak, sheep, and goats which furnish milk, leather, and meat, while the yak also serves as the national draught animal.

"Under these conditions, a normally large or increasing population would be simply a national tragedy," Dr. Koelz states. "Whether polyandry and a large and mainly celibate priesthood were consciously developed as remedies is difficult to say. Nevertheless both customs act as birth controls, since the number of children born is limited practically to the married women, and in turn the number of the latter is limited

by the prestige of religion, which draws a large percentage of the men to the priesthood. As priests, they not only occupy themselves with religious duties, but also govern the country and serve as teachers, scholars, and physicians. There are also large numbers of unmarried women, *jomo* or nuns, in the convents, a fact not so well known.

Radio Sets Jiggled to Death

A DEVICE that "jiggles" automobile radio sets 3425 times a minute with such force that a single vibration would jar a driver's hand loose from the steering wheel, is the radio industry's latest application of automotive "proving ground" methods.



The vibrating table on which auto-radio sets are jiggled to death

With the problem of ignition interference solved, vibration, according to John B. Hawkins, designer of the device, remained the one unpredictable factor in automobile radio practice. And Mr. Hawkins, who is production engineer of the Emerson Radio and Phonograph Corp., was not satisfied to wait two or three years to find out the actual result of repeated vibrations on a car radio of 1934 design.

Drawing, therefore, on automotive experience, he set up the auto-radio "proving ground" pictured in these columns. Test sets are clamped firmly on the upper shelf. A motor then shakes the shelf at varying speeds up to a maximum of 3425 times per minute. The apparatus is so designed that the set is vibrated in varying directions. The force of each vibration is roughly equivalent to driving a car over an 8 inch rut at 40 miles per hour.

Test sets were left on the device until they actually ceased to function. This brought to light the minor structural weaknesses which otherwise could not have been discovered without years of actual driving, and enabled the engineers to eliminate unsuspected sources of interrupted reception, before a single 1934 model was released.

Cider At All Seasons

CARBONATED beverages are now frequently made from fruit juice concentrates and carbonated water, instead of from synthetic flavors. Carpenter and Smith, of the New York State Agriculture Experiment Station, have tried to concentrate apple juice so it can be handled just as the bottler wants to use it; that is, by placing in the bottle a small amount of concentrate or syrup and filling the remainder of the bottle with ordinary carbonated water.

Whether to freeze the water out of the apple juice as ice, or to evaporate it by heating was their problem. Heating would drive off the aroma as a vapor unless it is condensed. As described in *Industrial and Engineering Chemistry,* they ran the juice through a tubular heater to coagulate the colloidal matter and cooled it at the other end of the tube to condense the aromatic vapors. When the concentrate was filtered some of the protein, pectin, and tannin was removed. The flavor was improved. Further concentration was at the risk of getting apple jelly. Russet and Rome Beauty apple juice could be concentrated to 55 percent total solids without jelly formation but Northern Spy went to 71; probably because the acid content is greater. As little as two to three ounces of the concentrate will make an eight ounce bottle of apple juice drink.—*A. E. B.*

World's Largest Photo-Mural

THE artist's drawing reproduced in these columns shows the special enlarging room built in the Kaufmann and Fabry plant, where negatives were printed to an enlargement of 35 diameters on photographic paper 40 inches high for the huge photo-mural in the Ford Building at A Century of Progress. In the lamp house are 7000 watts of brilliant illumination. Most of the printing was done after midnight when steadier electrical current insured greater uniformity of prints. The entire mural required about 12,000 square feet of photographic paper. At the time of the Louisiana Purchase Exposition, in 1904, the largest photograph in existence was ten feet long and two feet high. The Ford mural is 20 feet high and 600 feet long.

Depressed Freezing

FILTERING a melted organic substance through a warm filter of glass wool seems to remove the crystal "germs" or nuclei from it. It is from these centers that crystals grow when the substance is cooled and freezes. Without these germs the filtered liquid cools far below its freezing point without solidifying. German investigators, reporting in *Festschrift für Unorganische Chemie,* are not sure whether the germs are true tiny crystals which survive even after melting seems complete or whether they are particles of foreign matter with which the liquid is "inoculated." At any rate filtering through warm glass wool removes them.

Connected with this discovery may be an explanation of the important refinement in the grain of cast iron when it is heated far above its melting point before pouring into the moulds.—*A. E. B.*

Out-dated School Hygiene Ideas

NOT eating between meals, bathing for health, and many other health and hygiene rules still taught in schools and popularly accepted are definitely out-dated or are now regarded as unimportant by advanced medical science, writes Dr. Warren E. Forsythe, director of the University of Michigan Health Service, in the current Bulletin of the Michigan School of Education. Here is a list of commonly taught ideas which Dr. Forsythe considers either unimportant or actually harmful, from a strict health point of view:

That the evils of poorly ventilated rooms lie in the lack of oxygen and harmful increase in carbon dioxide. There is never a lack of oxygen nor excess of carbon dioxide. The essential problem of ventila-

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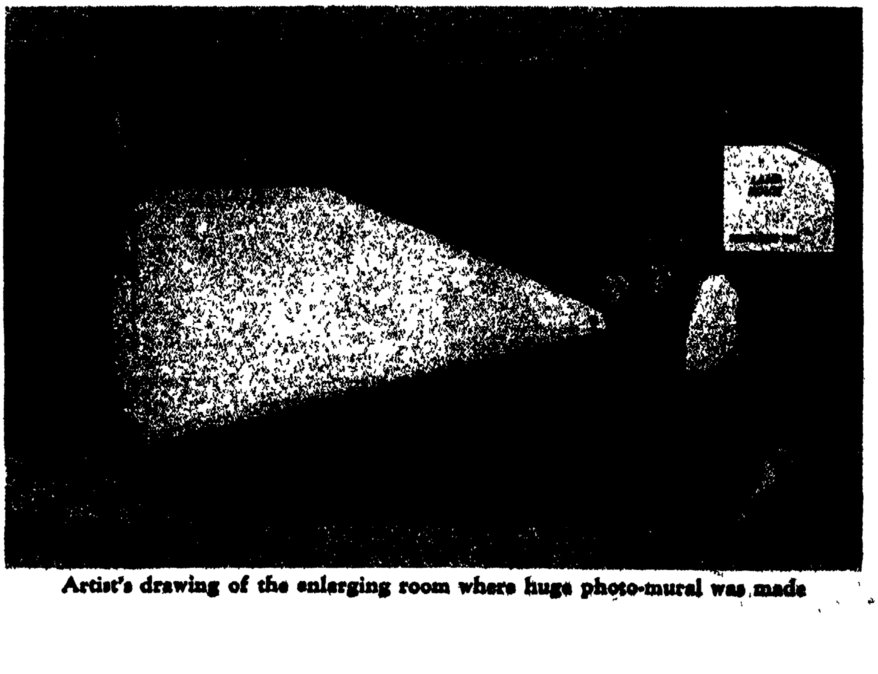


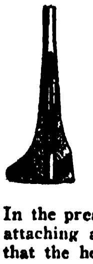
Artist's drawing of the enlarging room where huge photo-mural was made

RECENTLY PATENTED INVENTIONS

Conducted by A. P. PECK

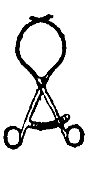
Golf Club

Patent Number 1958032, Louis Justin Cocke. It is well known that any golf club shaft, whether made of wood or metal, is likely to become bowed or bent because of readjustment of strains set up in the shaft when it is made, or by a sudden accident. Such bending of a shaft is highly objectionable because it prevents the user from getting the most efficient results from the club. In the majority of golf clubs the shafts have been attached to the heads in a relatively permanent manner so that they are not readily adjustable. Thus after the club becomes bent or bowed it is necessary to discard it or have an expert repair it. In the present invention means are provided for attaching a shaft to the head of a golf club so that the head can be removed with an ordinary screw driver. Also, the head can be rotated on the shaft and locked in any desired position Thus it is possible, if the shaft becomes bent, to rotate the head so that the bow may be brought into such a position that it will lie in a vertical plane through the axis of the shaft and the body of the user, in which position the bent shaft will have the least effect on the use of the club Furthermore if the head of the shaft becomes damaged it is possible to replace it, thus salvaging the undamaged part of the club.



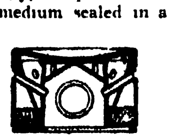
Tourniquet

Patent Number 1953074, Harry Cohen. The main object of the newly invented tourniquet illustrated in the drawing is to provide a device of this nature which is simple in construction, is easily applied to the limb of the patient, and extremely effective Because of the construction used in this device, it is possible to regulate the pressure exerted on the limb by the gripping members The parts of the tourniquet which are in contact with the flesh of the patient are so made that there is no tendency to cut or pinch the flesh The ratchet mechanism which is incorporated in the handle is so arranged as to lock the gripping members in any desired position.



Piston

Patent Number 1953109, Sam D. Heron In order to cool the pistons of a gasoline engine rapidly, the present invention provides for a cooling medium sealed in a chamber formed as part of the piston. This cooling medium also provides for the transfer of heat from the piston head to the skirt. The inventor states that the cooling medium employed is in liquid form at normal operating temperatures, metallic sodium, potassium, lithium, or other salts being used for the purpose

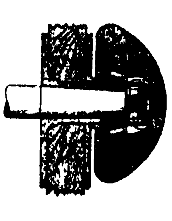


Insulating Material

Patent Number 1957822, Paul S. Denning. The present invention relates to insulation of buildings and so on, and more particularly to that type of insulation wherein the material is prepared in blocks or units Means are provided for employing insulating material in loose form yet so arranged that it can be used in assembled units. In the conventional use of insulating materials for sound and heat proofing, it has been the practice to place the loose material in position at the building site. Such an arrangement is objectionable because when used in the side walls of buildings, for example, the material will settle due to its own weight and therefore leave considerable vacant space near the top of the wall. By employing this new system, the insulating material is placed in unit containers having cells for containing it, thereby reducing to a minimum the settling of the material when placed in upright walls. These units can be piled up to form continuous surfaces of large areas without affecting in any way the insulating material in each of the individual cells. One type of unit for general construction work, showing the individual cells containing the insulating material, is illustrated in the accompanying drawing.

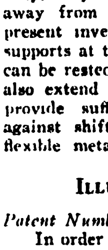
Safety Hub Cap

Patent Number 1955735, Thomas A Cheatham. The conventional type of hub cap used on automobiles is the cause of frequent trouble Coming close to obstructions, it often happens that the hub cap engages with some projecting part of the obstruction and the vehicle cannot be moved until the hub cap is released. Also in traffic hub caps are often hooked into by bumpers of other cars, frequently with disastrous results The object of the present invention is to provide a hub cap which will eliminate such possibilities. This is arrived at by producing a convex cap which is so mounted on an inner cap that it can freely rotate thereon As shown in the drawing, the inner cap is fastened rigidly to the wheel while the outer cap with its smooth surface is mounted on roller bearings Since this outer cap can rotate, it can often be disengaged from an obstruction or from the bumper of another car much more easily than the conventional type of hub cap



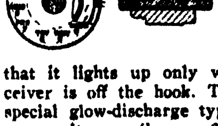
Portable Shower

Patent Number 1957956, Charles Hardy and Louis Bady. Portable showers consisting simply of a small spray head arranged with a flexible tube have been known for years but have proved disadvantageous because the hands of the bather are occupied in holding the shower and also because the spray may be, and frequently is, directed so that it falls outside of the bath tub. The present form of shower has been devised to overcome these and other obvious difficulties and consists of a ring which is supported by the shoulders of the user, thus permitting a shower of water to fall down vertically over the body. Any tendency of the shower ring to tilt away from the horizontal is overcome in the present invention by providing relatively rigid supports at the ends of the ring, which supports can be rested upon the shoulders of the user and also extend far enough below the shoulders to provide sufficient bearing surface to insure against shifting. These supports are made of flexible metal strips covered with soft rubber.



Illuminated Phone Dial

Patent Number 1955972, Melvin Edward Muse In order to provide for easy operation of telephones of the dial type, the present invention provides a special type of lamp to illuminate the dial under all conditions. This lamp may be so connected with the telephone circuit that it is constantly illuminated, or it may be so connected that it lights up only when the telephone receiver is off the hook. The lamp itself is of a special glow-discharge type designed to operate on a voltage as low as 24 volts, yet capable of withstanding the large increases in line voltage which take place when the dial is being used. In the patent specification dealing with this invention, two methods of mounting the lamp are proposed, one of which is illustrated in the drawing herewith. The lamp itself is, in general, circular in shape but of flat cross section so that it can be mounted beneath the figures on the lower dial, in which case these figures will be cut out so that the light shines through them.



Paste Tube

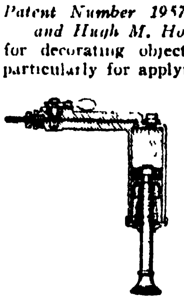
Patent Number 1956558, Bert C. Berry. This invention is concerned with producing a collapsible tube for paste of various kinds, from which the paste can be removed with the least possible difficulty. The invention provides a specially shaped head, as shown in the accompanying illustration, over which is placed a closely fitting cap held in place by a crimped portion which engages with a depression in the head of the tube. In both the cap and the head of the tube are located holes which can be aligned by turning the cap and thus permit the material within the tube to be squeezed out Turning the cap so that the holes are not in line seals the tube and preserves the contents Thus is provided a tube for various materials of a pastelike nature from which the cap cannot be lost and yet which has a closure sufficiently perfect for all ordinary purposes.

Hollow Concrete Objects

Patent Number 1955760, Clifford R. Nichols A new method of manufacturing hollow bodies or plastic materials is described in the patent issued to this inventor Guard rails and fence posts, lighting standards, telephone poles, porch columns, and so on, can readily be manufactured by this new process. A mold is provided and mounted in such a manner that it can be rotated Into this mold is poured a molten material such as paraffin, the mold being rotated to distribute the molten material evenly over the interior. After the paraffin is hardened, a suitable quantity of the proper mixture of plastic materials is introduced into the mold, the latter being continuously rotated to provide even distribution and at the same time a homogeneous mass. The mold is then removed from the rollers and placed in a kiln for curing and to secure proper hydration. After this has taken place, sufficient heat is applied to melt down the paraffin and thus release the product from the mold.

Marking Implement

Patent Number 1957545, William E. Krueger and Hugh M. Hodge. A marking implement for decorating objects with colored lines and particularly for applying stripes of paint to such objects as automobile bodies is the subject of the present invention. The device is simple and compact in construction and is claimed to be highly efficient in operation. It is provided with a reservoir for paint or other material, the supply compartment being so arranged that the liquid is gradually and evenly delivered to the nozzle. The whole affair is so constructed that it can be manipulated in a manner similar to an ordinary pen or pencil and thus is easy to use. The nozzle is so designed that the flow of paint can be controlled so as to produce lines of any desired thickness and of uniform width. In the illustration reproduced herewith is shown one type of the implement in which the supply reservoir and the delivery nozzle are made in one unit. In another form the reservoir and nozzle are separated but connected together by means of a flexible tube so as to permit unhindered operation.

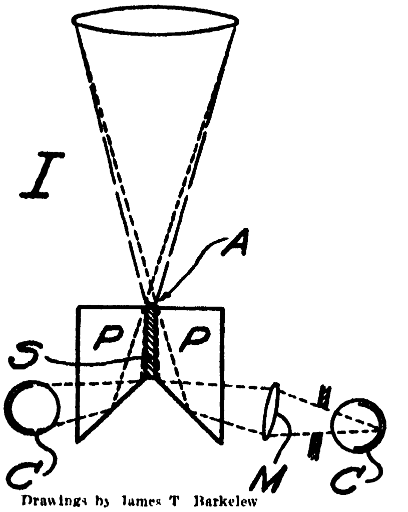


The above information has been taken from copies of patent specifications. No further details are available except as can be obtained from such specifications.

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

HERE is the contribution of James T. Barkelew, an engineer and patent attorney of Los Angeles (Great Republic Life Building), which we promised last month as a continuation of an article on photo-electric guiding of telescopes, written by Wilbur Silvertooth. It indicates how far he has progressed. Other amateurs are invited to take up the same problem and work on it. If a few amateurs will pound it hard enough,



Drawings by James T Barkelew

amateurdom may as a result have something to contribute to professional astronomy. Sic 'em, Tige.

Mr. Barkelew writes:

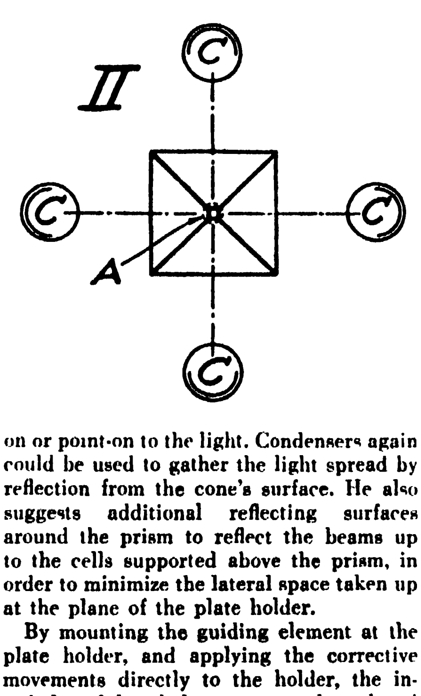
SOME time ago, George Mitchell and I did a little arm-chair work on automatic telescope guiding. George is a telescope nut. In his spare moments he is the guiding genius of the Mitchell Camera Corporation. In the course of evolving several different physical schemes for automatic guiding of telescopes, some shown in the sketches, we have found several difficulties that any successful automatic guide apparently must overcome.

The guiding star image is very small and of very low total illumination. In the form of I the square shim *S* between four totally reflecting prisms *P* (two shown) can be located out of focus, so that the enlarged image *A* will just occupy the shim end or somewhat overlap all of its edges. If the image moves, one or two of the light-sensitive cells receives more light, the opposite one or ones receiving less. A magnifier or condenser at *M* may concentrate the light on the cell.

In II a four-sided pyramidal prism has a small flat on top, and the image lies on or overlaps the flat, the light from the overlapping portions of the image being surface reflected to the four cells *C*. The smaller this point flat can be made, the better, as more light then goes to each cell. A major problem seems to lie in getting as much light as possible to each cell; the average guiding star that one can count on is so faint that the reliable sensitivity limit of the cell is closely approached.

The scheme of III was gotten up to offset small image size and normally to throw half the light into each of two cells. Here *H* is a half-transmissive mirror and *EE* are sharp edges adjusted to pass half images. This form, however, requires duplication for the other two directions. Other physical forms we have worked on involve oscillating edge plates and prisms which will periodically throw light from an image portion on the cells. Those are probably too complicated mechanically, and on the whole the single prism set in out-of-focus arrangement appears best, particularly as the small prism element may be put on a star image in the focal field of the main objective, along with the photographic plate.

One can readily visualize, mounted on the plate holder, a small element including the prism set and the cells. Microscopic observation of the image through the prism would facilitate setting. Russel W. Porter, who has made many suggestions [Nowhere in print, but orally; the two are neighbors.—*Ed.*] has suggested that the prism might be a cone rather than a pyramid, and that the cone, like a pyramid, could be set base-



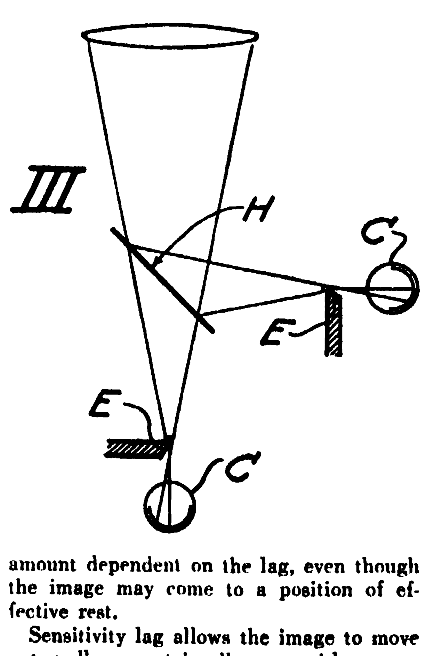
on or point-on to the light. Condensers again could be used to gather the light spread by reflection from the cone's surface. He also suggests additional reflecting surfaces around the prism to reflect the beams up to the cells supported above the prism, in order to minimize the lateral space taken up at the plane of the plate holder.

By mounting the guiding element at the plate holder, and applying the corrective movements directly to the holder, the inertia lag of the whole system may be reduced to a minimum. The plate holder may be made as light as possible, mounted on antifriction bearings; and the final driving motors, utilizing the amplified currents from the cells, connected directly to the plate adjusting screws whose pitch would depend on the load, the requisite acceleration, and the motor characteristics. A motor of small inertia seems indicated.

The inertia lag may thus be cut down to compare favorably with manual guiding. There is left, however, the sensitivity lag which is inherent in any such system and which appears to constitute the major difficulty.

In the sketch IV, lag *a* may represent the distance beyond edge *E*, or beyond normal, which the image must move in order to actuate the cell sufficiently to obtain a corrective result from the system. Suppose that *b* and *c* similarly represent time or inertia lags in the system. These latter may be reduced to much less than the corresponding lags in the average personal element in manual guiding; but the reduction of sensitivity lag *a* seems to present major difficulties.

Assume the simple movement of the image from a normal position, on an excursion out and back. Sensitivity lag not only puts the plate movement behind the image on the way out and back, but, most important, brings the plate back to a stopping position short by an amount primarily equal to the sensitivity lag. Now, if inertia lag is equal to sensitivity lag, then the over-run of the mechanical parts may make up for the sensitivity lag, and finally bring the plate to proper position. That, however, depends on the assumption that the image is going to move back to normal in a straight line—an assumption by no means justified. Furthermore, the simple case of the image having a normal position from which it makes temporary excursions is probably not the fact, although the image undoubtedly does predominantly occupy a definite small circle. The actual fact is probably a constantly moving image; but, whatever the conditions may be, the sensitivity lag has the effect at all times of putting the plate position behind the image position by an

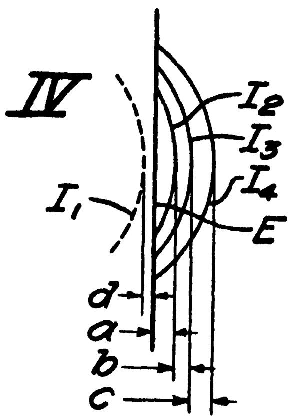


amount dependent on the lag, even though the image may come to a position of effective rest.

Sensitivity lag allows the image to move outwardly a certain distance without any corresponding control movement at all; the image can thus move around in a circle having a radius equal to the image radius plus the lag, without the control operating. And to attempt to correct the sensitivity lag by an equal inertia lag (over-run) thus means that the combined lag would be twice the

sensitivity lag, and the resultant star image very large.

The problem consequently seems to be one of eliminating the inertia lags and reducing the sensitivity lag to a very small amount. If the star image is of the order of 0.0001 of an inch, the *variation* in manual positioning by any one eye, while the image is still, is probably only a fraction of that amount. The sensitivity lag of an automatic control must thus be less than such fraction, to be worth while in improving photography.



Magnification of the image movement might help, but we have to remember that the guiding star image is now viewed through a magnifier, so that the magnified movements are availed of for following. The problem thus seems to resolve itself into one of providing an extremely sensitive system. One thought we have had in that direction is that the star image may be allowed to overlap all four edges in its normal position, thus normally affecting each of the four sensitive cells equally. Approximately one half overlap would give the greatest instant difference between increasing and decreasing overlaps. Then it might be possible to develop a balanced electrical system, such that a very minute unbalance of the opposing light-sensitive elements might result in a relatively very large current unbalance which would then be used for motive control.

Another manner of operating in the same way might be as follows. Instead of having the star image normally overlapping in all directions, let it normally overlap in two directions, say north and east. In other words, the constant tendency of the image could be to over-run in those directions. Then the two sensitive cell controlled currents might be balanced against two constant currents, with unbalance producing a large resultant.

All of this is about as far as we have gotten on the general subject, except to conclude that in any case the automatic system should have some kind of automatic occulter to cover the plate whenever the star image becomes so active as to run away from the control, or expands to a blur, or, what amounts to both those things, shimmers around rapidly.

MR. BARKELEW'S contribution, presented above, ends the discussion of this subject for the time being; the next stage being logically when somebody sends in something indicating results. In the meantime, we sound the last call for the annual convention of telescope nuts, to be held Saturday, July 21, at *Stellafane*, Springfield, Vermont. Everybody come.

THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 98)

tion is one of heat regulation. The flow of heat from the human body determines in part its comfort and health.

Deep breathing exercises. Dizziness or actual faint may follow when these are enforced. Such excessive "washing out" of the carbon dioxide in the blood is useless if not harmful. Breathing should be only in response to body activity.

That washing out the interior by encouraging drinking large amounts of water is good for the system. Given a ready supply, normal people will drink what they really need. Related to this is overemphasis on constipation, intestinal regularity, and laxatives. "The troubles attributed to autointoxication are more mythical than real."

Especially when we were children we were told, "Don't eat between meals." However, social custom alone has set the time for eating, and between-meal "piecing" need not be harmful if the total quantity and quality of food are sufficient. Related to this is the taboo against combining sour foods and milk; the normal stomach secretions are always more acid than any food.

"Green apples cause stomach ache." These much maligned fruits, and other foods, have been blamed for many stomach aches which were in reality symptoms of appendicitis or some other serious internal trouble. Taking physics under these circumstances "comes under the heading of suicidal procedures."

"Keep clean to be healthy." Bathing and washing are important "for esthetic and social reasons," but their health virtues are difficult or impossible to prove.

"Kidney disease." The layman's symptoms of pain in the back and urine irregularities are in fact rare in kidney disease and the association should be dropped.

"Take some medicine." Don't, unless the doctor gives it, and do not force him to do so if he apparently does not think it necessary.

"Stand up straight." Personal appearance and self respect should dictate a good posture. It is likely that good posture depends on good health and not vice versa.

"Drink more milk." Usually not bad advice. Milk is a nearly complete food, but many are "sensitized" to it and suffer skin rashes and gastro-intestinal symptoms more serious than the benefits received.

New Farm Tillage Laboratory

A NEW farm tillage laboratory—the only one of its kind in the world—in which studies will be made to find the types of machines best suited economically to the soils of the southeast, will be built by the U. S. Department of Agriculture, at Alabama Polytechnic Institute, Auburn.

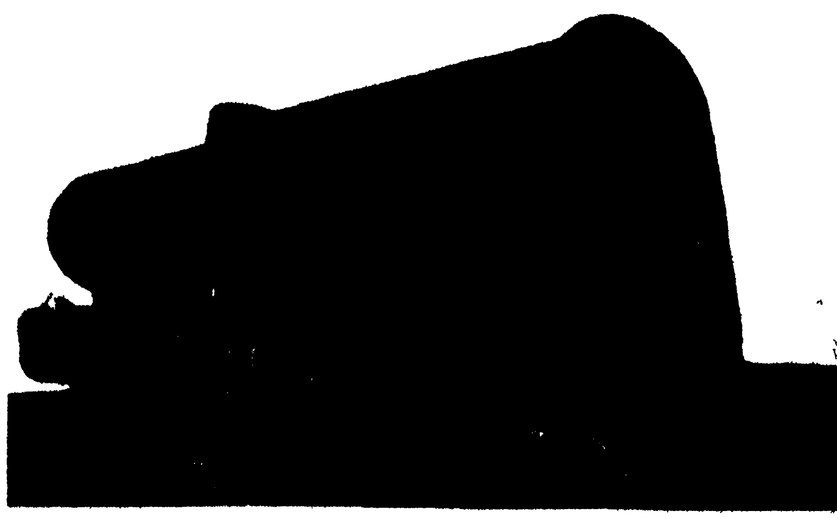
The Federal Bureau of Agricultural Engineering will construct nine shallow pits, each 20 feet wide, 250 feet long, and 2 feet deep. Into each pit will be dumped 10 carloads of topsoil, a sample of one of the agricultural soils of the southeast, ranging from sand to clay. In these parallel pits the bureau can make practical comparative tests of plows and cultivating machinery at one location, working under controlled conditions.

R. B. Gray, chief of the Mechanical Equipment Division of the bureau, will supervise the new laboratory work. John W. Randolph, a bureau engineer, will have charge of experiments and will work in co-operation with M. L. Nichols, head of the Department of Agricultural Engineering of the Alabama Institute.

All plots will be adequately drained, and will be separated by concrete walls extending a few inches above the plot levels. The laboratory will be built with funds obtained from the Public Works Administration and will cost about 110,000 dollars. The land upon which it is to be built is the property of the state of Alabama.

Converted Locomotive Is More Powerful

A LOCOMOTIVE which is said to be capable of doing the work of two ordinary engines has just been completed by the Baltimore and Ohio Railroad. Since this 4-6-4 type has been converted from a 4-6-2 and its working pressure greatly increased, some of the details, as passed on to us by



Fire box and boiler of converted locomotive

The powerful B & O locomotive after conversion

Mr. G. H. Emerson, Chief of Motive Power and Equipment, are quoted below:

This locomotive No. 5047, Class V-1, 350 pounds boiler pressure and 74-inch drivers was reconditioned by lengthening frames to replace the two-wheel with four-wheel trailer truck and new boiler at the Mount Clare Shops of the company in Baltimore, Maryland, being designed from designs made in the Mechanical Engineer's office, for hauling 14 car trains, such as compose the Capitol Limited on our lines between New Castle Junction, Pennsylvania, and Chicago, Illinois—a distance of 424 miles.

To supply steam to maintain sustained speed, the Emerson water tube firebox boiler was used in its construction having a boiler capacity of 124.0 percent. (Cole's rating.)

This design of water tube firebox boiler has passed the experimental stage, as this company has been applying them for several years, and consists of a double row of staggered tubes forming the side wall of the firebox, set by rolling into a bottom header connecting the front and back water legs, with the upper ends of the tubes set into the top header, located alongside of a single steam drum forming firebox crown, making a centrally disposed connection with the barrel of the boiler.

The header is connected to the drum by cross circulating tubes of a larger diameter than side tubes, and with wider spacing which checks too rapid circulation.

Washout plugs are located in the top and bottom headers opposite the ends of the rows of tubes for inspection and cleaning purposes. This convenient arrangement avoids the entrance of the workmen into the steam drum for cleaning the tubes, saving considerable time and labor in the operation.

The water tube side walls present per foot of length of firebox a greatly increased heating surface exposed to the action of the radiant heat, and have resulted in much more efficient steam generation.

Mr. Fowler, from experiments reported to the Master Mechanic's Association, at one time stated that the value for heat transfer of firebox heating surface was eight times greater than the boiler tube heating surface.

This design lends itself to being extended forward to increase firebox capacity to take advantage of the higher value of the radiant heat.

The 5047, a 4-6-4 type with tractive power of 52,000 pounds without booster, and 64,000 pounds with booster, will do the work of two of the former P-1c, 4-6-2 type locomotives of 46,000 pounds tractive power formerly used on these runs.

A comparison of the elements shown below of the water tube boiler of the 5047 with the conventional staybolt firebox of the P 1c will give the points contributing to the super performance of the 5047 boiler.

New Boiler with Water Tube Firebox

Tubes No & Diam	205	2¼"
Flues	40	5½"
Over Tube Sheets	16' 1¼"	
Firebox Size	96" x 132"	
Grate Area	88 Sq Ft	
Boiler Capacity (Cole's rating)	124 0%	

HEATING SURFACES (Sq Ft)

Firebox	825
Tubes & Flues	2853
Total	3678
Superheating	1015

EVAPORATION (lbs)

Firebox	45375
Tubes	19610
Flues	10380
Total	75374

Conventional Staybolt Firebox Removed from P-1c Loco.

Tubes No & Diam	218	2¼"
Flues	34	5½"
Over Tube Sheets	21' 0"	
Firebox Size	81" x 120"	
Grate Area	70 0 Sq Ft	
Boiler Capacity (Cole's rating)	91 0%	

HEATING SURFACE (Sq Ft)

Firebox	256
Tubes & Flues	3706
Total	3962
Superheating	811

EVAPORATION (lbs)

Firebox	14080
Tubes	23019
Flues	9975
Total	47074

Bothersome Bacteria Commit Suicide

BEATING bacteria at their own business has made money for the manufacturers of fiber-board. One popular variety of fiber-board is made from the tough fibrous pulp remaining after sugar cane is ground up to extract its sugar. This material, known as "bagasse," piles up around the sugar mills during the three-months' grinding season faster than it can be manufactured into fiber-board. Its storage has long presented a problem, for the bagasse is subject to attack by bacteria, molds, and fungus. Now, however, E. C. Lathrop and T. B. Munroe, two chemists of the Celotex Company, have devised a method which forces the bacteria to commit suicide and to kill off the molds and fungi that formerly ravaged the raw material.

The secret is simple. The scientists found that by merely gathering the bagasse into bales, the bacteria, feeding on the residual sugar in the fiber, would produce heat by fermentation sufficient to raise the temperature at the center of the bale to 142 degrees, Fahrenheit, and keep it there for two or

three months, thus effectively killing off the micro-organisms which cause decay.

The carbon dioxide evolved during this fermentation seems to carry away with it so much water vapor that only 30 percent moisture is left in the bagasse instead of 50 percent as it comes from the mill. In this drought the spores which survive the heat do not develop even after the mass cools. Boric acid is spread over the tops of the bales on the outside of the pile of bales where the temperature is lower and a roof covers the pile to keep off rain.

The money savings in the first year were five times the total research cost.—*A. E. B.*

Simple Fire Alarm

ONE of the simplest fire alarms which has come to our attention recently is in the form of a small fuse that will melt and form an electric contact when heated to 130 degrees, Fahrenheit, with the result that an electric bell will be started ringing. This fuse is mounted in a cartridge housing of the shape and size of an ordinary 15 ampere electric fuse and is held in place on a fuse block. It is called Thermotact.

The wire attached to this fuse is connected to the electric door bell of a residence. When a temperature higher than 130 degrees is reached in the vicinity of the Thermotact, the continued ringing of the bell acts as an alarm. Obviously it is dependable because the door bell is usually kept in working order because of the regular demands made upon it.

A number of these devices scattered about the home—in the attic, the basement, the kitchen, or closets—should serve effectively to protect all parts of the home.

A Less Poisonous Insecticide

THE introduction of barium fluosilicate as an agricultural insecticide some few years ago by one of this country's oldest chemical organizations was styled by an authority as the greatest development in insecticides since the introduction of lead arsenate in the late years of the 19th Century.

Private research activities on fluorine compounds as agricultural insecticides over a period of years resulted in the ultimate selection of barium fluosilicate as a most practical material. Preliminary trials had indicated this material to be of high killing power to many important chewing insects, and with a high factor of safety to foliage of most plants.

The study of barium fluosilicate then progressed to field trials under commercial conditions, and the material gave indications of being effective on practically all insects which the old materials had controlled, and on many of those important insects which had not been satisfactorily controlled by the old combinations. Freedom from foliage injury in practically all trials, and practically no changes in spraying or dusting equipment or technique of application, were additional factors in favor of this new chemical insecticide. It is not necessary for the insect to feed on a host plant in order to get enough of the material to cause death. The very fact that the insect travels through the material on the plant or on the soil surface around the plant places it in immediate danger of death.

While it is apparent from entomological research that fluorine compounds are more toxic to many insects than lead arsenate, the work of Henry Field Smythe and Henry F. Smythe, Jr., as published in *Industrial and Engineering Chemistry*, indicates that with respect to humans, fluorine compounds leave a much wider margin of safety. Specifically, this work reports that thirteen times as much barium fluosilicate is needed as lead arsenate to give the same chronic toxic effect from repeated doses. It is concluded that the use of fluorine insecticides would leave a much wider margin of safety than do arsenical materials between the weight of spray residue on fruit and the amount toxic to the consumer.

Byrd's Hermit Hut in Antarctica

BETWEEN Admiral Richard E. Byrd and the bleak Antarctic, where the thermometer drops to almost 100 degrees below zero, there are only the slim walls of his hut, a bare four inches in thickness. Within the hut, he has a cook-stove, a small heater and a lighting arrangement—to-

The first assembly of Byrd's south polar hut, showing aluminum foil insulation

gether consuming only four quarts of oil a day. Yet the Admiral reports that his quarters are decidedly livable.

Four quarts of oil . . . four inches of wall . . . on the hem of the South Pole! It doesn't sound possible. And it wouldn't be, except for the intervention of science in the form of two paper-thin layers of aluminum foil or metallation. Embedded in the wall, they throw the heat, generated by the cook-stove, the heater, and the lights, and even from the Admiral's body, back into the room, much in the manner of mirrors. It has been demonstrated that only about 5 percent of radiant heat which strikes aluminum foil goes through—95 percent is reflected back.

This white man's igloo represents so remarkable a feat in the difficult art of keeping warm, that it is being exhibited in replica at A Century of Progress Exposition in Chicago. It occupies the plot facing the Byrd ship, *The City of New York*, which attracted hundreds of thousands of visitors last year.

The hut is 9 feet wide by 13 feet 1 inch long by 7 feet 1 inch high, the size of an automobile crate. Wooden pins are used in many parts after the fashion of old barn builders. A two-way trap door in the roof is security against the Admiral being hopelessly buried beneath the snow. Vents for fresh air and for carrying away cooking fumes are provided, as well as a tunnel and a porch walled in by packing cases containing supplies.

The house was made in panels to facilitate dismantling and assembling. Each panel has on the inside a layer of fireproof canvas which is glued on white pine veneer 1/8 inch in thickness, covered on both sides with tough paper. Next comes a layer of heavy paper on both sides of which were glued the aluminum foil. The metallation, made by the Reynolds Metals Company, was inserted loosely and not glued to the veneer, in order to create air spaces. Back of this and progressing toward the outer wall came a sheet of waterproof paper, wavy of surface and not fitting snugly against the foil.

A half-inch blanket of kapok came next, then another sheet of waterproof paper, then another blanket, another sheet. A layer of heavy paper coated on one side only with metallation facing inwards was next, and finally another panel of paper covered veneer. All of it was held together by a strip of white pine four inches wide and one inch thick.

New Study and Reading Lamp

SEEING conditions in our schools and universities are in line for considerable improvement, following a nation-wide survey of the lighting in the study rooms of dormitories and fraternity houses by the Illuminating Engineering Society.

In its survey, the Society found that the lighting conditions were far below the standard of good practice and are largely responsible for the 40 percent of defective eyesight existing among the student class in this country. In many instances the severe economies, necessarily, but unwisely practiced during the depression, placed restrictions on the amount of light available. Consequently, the level of illumination on the average study desk was usually so low that it seriously impaired the vision of the students while they themselves were unaware of the fact.

The new study lamp, showing direct and indirect lighting features

As an outgrowth of these disclosures, the Illuminating Engineering Society is recommending a lamp of special design for the study rooms of our college dormitories and fraternity houses. Modelled after an ordinary table lamp, this new design has an inverted bowl of translucent glass, open at the top, and produces a combination of direct and indirect illumination. The standard 100-watt lamp which is specified for the I.E.S. study and reading lamp, is somewhat larger than that generally found in such lighting units. Surface brightness of the light source, however, is kept below three foot-candles per square inch by the translucent glass of the bowl.

The open-top bowl in the I.E.S. study and reading lamp sends considerable light to the ceiling and produces a good level of indirect illumination which lifts the familiar veil of darkness around a study desk and throughout the room. Removing the sharp contrast between the bright spot of illumination on the desk top and dark shadows in the remainder of the room is expected to be an important factor in combating eyestrain. Student's eyes will be spared the continual readjustment which tires the muscles and encourages strain.

With a height of 28 inches, the I.E.S. study and reading lamp is considerably taller than most designs, which usually are so squat as to be of little value except perhaps as a decorative feature. It is this height, however, which is an important factor in the good distribution of direct light on the desk top.

Anxious to remove, once and for all, the evil of improper lighting in study quarters, the Illuminating Engineering Society offers to certify all study lamps which conform to specifications.

Salmon-Liver Oil

PRESUMABLY both the cod fish who supplied the liver and the children who are coaxed to take the oil will be pleased to learn that the salmon threatens to dethrone the cod as a source of vitamins. Two chemists of the United States Bureau of Fisheries, Charles Lee and Chester Tolle, have discovered that oil extracted from the liver of salmon contains more valuable vitamins than cod-liver oil. There are 500 million pounds of salmon caught annually in this country, they state; of this weight 2 percent is liver and 3 percent eggs. The livers are 5 to 8 percent oil, the eggs 10 to 12 percent.

Tests were made on the vitamin A and vitamin D potency of the two kinds of oils by feeding measured doses to rats. The results of tests reported in *Industrial and*

Engineering Chemistry show that salmon-liver oils are approximately 5 to 20 times as potent in vitamin A and twice as potent in vitamin D as is cod-liver oil. The oil from the eggs was in no case superior to cod-liver oil either in A potency or in D potency.—*A. E. B.*

Face Powder from Apricot Seed

FROM apricot seed, Great Britain manufactures face powder, Germany high explosives, and an Australian firm confectionery. The state cannery at Leeton, New South Wales, has discovered the fact and is rejoicing accordingly. They have just disposed of a 50-ton dump of "stones" at 250 dollars a ton.

In Victoria, where most of the apricots are grown, orchardists are much cheered at the thought of being thus able to turn to profit the portion of the fruit that was formerly wasted.

Wines Clarified by Skim Milk

FILTERING a wine may leave it bright but upon standing a short time, it may again throw out a cloud. Many methods using powders such as silica gel, bentonite, or barium sulfate and talc work well in some cases but Blumenthal and Blumenfeld in the June issue of *Food Industries* describe methods which give uniformly good results.

One is to add one ounce of skimmed milk for every 50 gallons of wine and filter it without waiting for it to settle.

Adding 2 ounces of vegetable carbon to 50 gallons of cloudy wine, agitating, settling for 48 hours and filtering through ashes to pulp also gives good results. The bouquet lost by the wine is negligible. The charcoal also causes a young wine to take on age, especially if it is a white wine. —*A. E. B.*

Acetyl-Choline May Prevent Benzene Poisoning

THE many cases of sudden death due to benzene poisoning that occur each year in various industries where benzene is commonly used as a solvent may be prevented by an injection of the drug, acetyl-choline. This announcement was made recently before the New Haven Medical Society by Dr. Louis H. Nahum, of the Yale Medical School, who told of his work in this field with Dr. H. E. Hoff, also of the Yale medical faculty.

Benzol vapor, Dr. Nahum explained, produces an abnormal sensitivity of the heart to adrenalin, a common constituent of the blood, bringing about an irregularity in the heart beat which causes death. Adrenalin, incidentally, is sometimes injected into a heart that has stopped beating, in an effort to restore life. Excitement and physical activity predispose to the occurrence of sudden death by benzol vapor. Excitement, moreover, is a condition in which the adrenalin glands pour into the blood large amounts of adrenalin. Animals deprived of adrenalin did not die of ventricular-fibrillation, the fatal irregularity of heart action which appears to be the cause of death in benzene poisoning.

"We found, further, that an injection of acetyl-choline counteracted the action of the adrenalin and protected the animals against this fatal irregularity," Dr. Nahum said.

This finding, while important in itself, opens up a new field of investigation of the causes for death by heart failure. Adrenalin under abnormal conditions, one of them being exposure to benzol vapors, produces ventricular-fibrillation.

Whether other conditions, heretofore overlooked by physicians, predispose the heart to the lethal action of the adrenalin, remains to be investigated.—*Science Service.*

CURRENT BULLETIN BRIEFS

THE CARRIER WEATHERMAKER—MANUFACTURED WEATHER FOR THE HOME, describes the Carrier Air Conditioning System which is used in industry and the home. This is one of a number of pamphlets on allied subjects: The others are entitled "Why Fight The Weather?", "Carrier-Brunswick Refrigeration," and "Air-Conditioning Principles and Equipment." *Write Scientific American for Booklets 8A.—Gratis.*

THE OLDER EMPLOYE IN INDUSTRY. This is one of the many publications issued by the Policyholders' Service Bureau in the interest of better management in business. There are many factors involved which are adequately dealt with. *Metropolitan Life Insurance Company, 1 Madison Ave., New York City.– Gratis.*

WORLD UNITY AS RECORDED IN HISTORY. ("International Conciliation," February, 1934, No. 297.) By Elbert D. Thomas, United States Senator from Utah, formerly Professor of History and Political Science at the University of Utah. In his brief treatment of the subject Senator Thomas cites interesting examples in support of his thesis and stresses the necessity of a broader interpretation of historical events if unity of action on present-day problems is to be attained. *Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass.—5 cents.*

THE GENERAL ELECTRIC INSTITUTE. Now a new and greater Institute unites under one roof the function of three Institutes that were previously separate—the Lighting, Kitchen, and Refrigeration Institutes, with the most modern equipment and much of the best available teaching talent. The new Institute is prepared to give a unique training, intensive and highly practical. Strange to say, it is a training center with no tuition. A beautifully illustrated pamphlet may be obtained by writing to *The General Electric Co., Nela Park, Cleveland, Ohio.—Gratis.*

UNITED STATES EARTHQUAKES IN 1932. By Frank Neumann. *Superintendent of Documents, Washington, D. C.—5 cents coin.*

RAILWAY AND LOCOMOTIVE HISTORICAL SOCIETY, INC.—NEW YORK CHAPTER. Now more than a century after the advent of the railroad an organized effort is being made to bring together all available relics portraying the tremendous growth of this

country's greatest industry. Those who would like further information and literature should address the *New York Chapter, Post Office Box 434, Madison Square Station, New York City.—Gratis.*

BACON'S PUBLICITY MANUAL is a complete and up-to-date directory of 1600 American and Canadian business and trade papers, classified by markets, with an analysis of the types of editorial material used by each publication. There are also many practical suggestions regarding preparation of manuscript and illustrations. *R. H. Bacon & Co., 608 South Dearborn St., Chicago, Ill.—$3.00.*

SCIENCE REPLIES

(Continued from page 79)

velopment work, failure is a common thing and, if we gave up the principle every time an experiment failed, we could accomplish nothing. Our civilization as a whole is new. It is in itself an experiment. Just because we have encountered difficulties is no cause for despair. We must find out what is wrong and remedy it, but we must not give up hope of a better and more secure life.

We are being told that if we develop new things we must accept the responsibility of seeing that they are properly used. We believe that many of the principles that have been developed in the physical sciences can be used in the study of the social sciences and we stand ready to contribute in any way that we can to this work.

Most people think that science and industry are interested only in the development of labor-saving machinery. This is entirely a false notion. We must not forget that for the past 50 years when the great building of our railroads, cities and industrial plants was going on, this labor saving was a most important thing because we did not have enough people to do the work. And only five years ago we had a scarcity of labor in this country.

Science is very much more interested in the production of labor-producing projects and inventions, than in labor saving. I cannot help but feel that in a very short time we are going to break loose another great piece of basic information which will keep us industrially busy for a great many years to come.

If you will only recognize how much there is yet to be done that will be of general good to the whole human family, then we need not worry, but we must be bold enough to take those forward steps which will bring back prosperity in any measure that we desire, or in any measure which we have imagination enough to conceive.

From DR. ABBOT:

I HAVE read Secretary Wallace's article with much interest and sympathy. From general principles it seems clear that the more bountiful is Nature and the more clever and informed is man, the greater should be human comfort. If society were as well organized as scientific research must be to attain success, the reduction by means of research of the amount of work required to provide necessities, comforts, and reasonable luxuries for everybody would be no evil to anybody, but a universal blessing. In other words, it is not work but the products of work that people need.

Greed, dishonesty, distrust, and incompetence stand in the way of such a social reorganization. Whether society can function automatically, as heretofore, and accomplish the desirable end of giving everybody reasonable comfort from childhood to old age, is uncertain. Whether general consent and support can be gained for a social organization wherein an intelligent government would cause want and supply to coordinate harmoniously, is doubtful.

Secretary Wallace implies that those whose acute minds and prolonged training fit them for scientific research ought to devote themselves to the improvement of social organization. No doubt he would agree that some kinds of scientific specialists would waste their time if they turned from their present pursuits to these social problems.

Possibly, however, he might approve a plan whereby the National Academy of Sciences, co-operating with other scientific organizations, should appoint a large committee with power to add to its membership, and to solicit moderate financial support, to the end of making recommendations as to practicable improvements in our social organization. Scientific men are accustomed to meet and conquer difficulties of a physical nature in their experiments. Perhaps such a committee might devise ways and means to overcome the four giants named above, which bar the path to happiness.

RESEARCH AND THE MOTOR CAR

(Continued from page 63)

tests under conditions representing the severest requirements of actual use. We cannot recall any other engineering laboratory or workshop where this principle has been so fully recognized and applied.

The owner of a modern automobile must have his car start up in the severest of cold weather. Accordingly a huge cold chamber is provided in which an entire car can be submitted to a temperature of —20 degrees Fahrenheit; it is expected to start functioning immediately after the ordeal. A smaller cold chamber is specially directed to the study of low temperature effects on the carbureter.

Some years ago automobile dealers in Belgium found that the roads of that country made of cobble stones with a disconcerting and pronounced rise in the center caused trouble in the sturdiest American cars. From this developed an instrument of torture called the Belgian Roll. In the use of this device, a car, fully equipped and ready for operation, is lashed down at one end and mounted on four double sets of huge rollers. These rollers are revolved at varying speeds, and on their surfaces have projections several inches in height, arranged unsymmetrically. The car is therefore subjected to an agonizing ordeal where high speed is combined with unequal and violent jolts and bumps fore-and-aft, and side to side. The car can be studied from below as well as at the sides while undergoing this test. From an engineer's point of view, the Belgian Roll is

preferable even to repeated road tests in rough territory because the violence of the test can be systematically varied, intensity of test can be crowded into a short space of time, and the possibilities of systematic observation are greater.

In another part of the laboratory we observed an armored chamber of steel and wood, embedded in the floor, where flywheels can be spun up to a speed of ten thousand revolutions per minute or up to bursting speed, to determine their ultimate strength.

Perhaps no element of the car must be so perfectly reliable as the steering gear, and we inspected the steering mechanism testing jig with considerable respect. A rack moving with a rapid reciprocating motion turns a pinion to-and-fro. The pinion in turn oscillates the steering wheel and steering column, whose lower end functions against a heavy load imposed by a hydraulic plunger which resists motion in either direction. A few hours on the steering-wheel jig is equivalent in its destructive effects to several years of heavy driving on the road. The report of the engineer after such a test is the most instructive comment the design office can receive.

Elsewhere a sound-proof door was opened for our benefit and we saw an array of different types of horn. Through an electric make-and-break system these horns were continually sounded, several times a minute for days at a time. Even a Paris taxi driver with his continuous "honk! honk!" could scarcely put an automobile horn through an equal trial.

Interior fabrics have little connection with safety, but ladies dislike faded fabrics. Therefore, an ultra-violet ray test for fabrics has been devised and is constantly employed. Another curious mechanical device pulls, bends, and twists fabrics simultaneously, providing a test of wear and strength under conditions more severe than those of use. These tests are only representative; safety and reliability are not tested only in the laboratory. Records of prolonged road tests are systematically studied and recorded, with the young men of the Chrysler Institute of Engineering receiving practical training in how a beautiful design on paper stands up in actual usage.

NEEDLESS to say, the study of materials is an integral part of automotive engineering. There is always an active exchange of ideas between metallurgists, chemists, and the car builders to the benefit of all concerned. In many instances, the automotive engineers have themselves made advances in the treatment or application of materials. In viewing the metallurgical and chemical laboratories we were particularly impressed with two developments—one the use of powdered metals, the other an intensive use of rubber in car construction.

At first sight it would seem rather a waste of effort to powder pure metal, but engineers have even gone so far as to powder pure metals and then to re-consolidate them in the form of rods, bars, and tubes. The most striking instance of such use in the so-called "oil-less bearings" the trade name of which is Oilite. Several years ago it was found that the so-called "oil-less" bearings were unsatisfactory, the principal deficiencies being lack of lubrication, rapid wear, scoring, and disturbing noises in operation. Accordingly the Detroit metallurgists undertook to develop their own oil-less bearings.

"Oilite" is made of copper, tin, and electric furnace graphite, all carefully powdered so that they will pass through a 150-mesh screen. These are carefully weighted, thoroughly mixed and fed into an automatic briquetting machine. Bearings are formed under very high pressures to any desired form. Subsequent operations are heat treatment and impregnation with oil, and final sizing of the outside and inside diameters. For heavy duty, satisfactory bearings have been made containing 30 to 40 percent by volume of oil.

It was a most interesting sight to see the metallurgist, W. G. Calkins, place one of the bearings in a vise and see the oil form in a heavy film on the outside of the bearing as pressure was applied.

We now turn to another material in one of the applications of which Chrysler engineering has led the way—rubber. We are, of course, not referring to rubber tires, in which the tire manufacturers remain preeminent. In 1926 a "rubber research project" was started. At that time about three pounds of rubber was used in every car, aside from tires. Cars now being shipped carry from 50 to 65 pounds of rubber, exclusive of tires, and the use of this material in the 1934 lines represents an increase of as much as 15 percent over 1933. Perhaps the most striking results of this research project were in the development of rubber engine mountings with their anti-vibration qualities, and in the adhesion of rubber and steel—now said to be the biggest advance in the mechanical rubber goods field.

Physics, chemistry, metallurgy, and mechanics were all brought into play in the original research, and now by means of suitable chemical treatment, electro-plating, and pressure application, the adhesion strength of rubber to metal is as great as the strength of the rubber itself! This means that rubber can be used as a connecting unit instead of the customary steel bolts or screws. Since rubber damps vibration, it can be seen at once what a wide scope of use is opened up.

PERHAPS one of the most significant elements in modern American industry is in the constant seeking after beauty. Nowhere is this more true than in the automobile. The modern American motor car is perhaps the most beautiful product of the machine age. Until recently this evolution toward beauty has been unconscious; now it is conscious and directed. Let us see what activities H. V. Henderson, a genial giant of six and a half feet in height, and head of the Chrysler art department, has brought into being.

An architectural engineer of French training, Mr. Henderson has sought and obtained the atmosphere of a Paris atelier coupled with the utilization of modern applied science. Thus, while he and his able assistants are as alive to the beauties of color as an artist, they use the most modern applications of photo-electric cells in matching and combining colors. With 15 basic colors to start from they have developed a new and scientific form of color nomenclature embracing perhaps 1500 shades and combinations.

No manufacturer, engineer, or draftsman, or for that matter scarcely anyone, can

fully visualize true appearance and beauty of an object from cold blue prints. A model is infinitely better. Mr. Henderson has his artistic draftsmen draw up templates and build large numbers of tenth scale models—weighing perhaps 35 pounds. A preliminary selection results in the construction of plaster of Paris models, less flexible but more permanent than clay. These small plaster of Paris models are painted and finished for future reference. When the small models have served their purpose, full-size clay models weighing perhaps three tons are constructed and serve as nothing else possibly could, as a basis for judgment by executives, designers, and sales managers.

Similar principles apply in the artistic design of car interiors, where perspective drawings are used to better purpose than actual models. The industrial artists do not stop at work on the car as a whole, however. They work up by similar meticulous methods such minor objects as hub caps, door handles, and so on. Here are apparently minor but really very important points. Women will not buy cars if the door handles tend to cut their gloves. Models of door handles are cut out of wood, glued together, smoothed down, and tested for appearance and feel until every practical and esthetic requirement has been met. Similar care is lavished on curtains, moldings, instrument panels, and the hundred and one other visible parts of the modern car. Art magazines, European and American, are fully and widely used for suggestions and ideas, and the "art" discussions at the noon lunch hour are singularly akin to the talk of a modern studio.

THE continued success of an industrial research laboratory depends on the ability of newly admitted personnel, as well as on the growth in knowledge of the veterans. It was interesting to see how the Chrysler Institute of Engineering functions with these two ends in view. Established three years ago, the Institute is incorporated under charter of the State of Michigan with authority to confer degrees in engineering and to issue credits in preparatory school work. To secure admission to the Graduate School of Engineering, a Bachelor of Science degree in engineering is required. Selection by a special committee entails careful examination of the man's scholastic record, other activities, and a number of personal interviews.

The Board of Governors of the Institute has been successful in recruiting really outstanding men from such schools as the University of Michigan, Massachusetts Institute of Technology, Cornell, Iowa State, Harvard, Princeton, and so on. The two-year course leading to the degree of Master of Mechanical Engineering involves nine hours a week of class and lecture work combined with regular related employment as junior engineers in various departments of the laboratories in the first year. Only on completion of this course is the junior engineer definitely assigned to one department for which he has shown special aptitude.

With a distinguished engineer and teacher, Professor John J. Caton, in charge, the faculty (serving voluntarily) is drawn from the leading engineers of the organization. Automotive engineering, thermodynamics, metallurgy, machine design, mathematics, and a number of cultural subjects such as economics and commercial law constitute the curriculum.

Any friction or jealousy which might possibly be aroused among the non-college personnel by the introduction of technical school graduates is forestalled by a five-year undergraduate evening course offered by the Institute. Some of the young college men are themselves instructors in the undergraduate classes.

The plan is admirable in conception and equally well executed. Besides its educational advantages, and its advantages in personnel selection, we see in it possibilities of democratic influence. College men learn from draftsmen and shopmen. The draftsmen and mechanics learn from the graduates of our greatest universities. An industry permeated with such contacts is likely to be harmonious and friendly.

WE do not know what plans for future progress these automotive executives and engineers have, but they surely would not maintain these splendid laboratories and seek out more young men through their Institute of Engineering unless they had constant advances in view. Let us merely guess at some of the things they may be doing in the future.

First of all we may expect further developments in streamlining. The Airflow cars already show marked superiority over the conventional sedan of a year or two ago, but a great deal remains to be done. Minor obstructions such as exposed door hinges cause a great deal more air resistance than is at first apparent. An exposed spare tire at the rear may ruin all the careful design of tail lines. Perhaps a way may be found of actually giving the car a fish-like tail without lengthening the car excessively. It is possible also that even more radical changes may be made with the ultimate in streamlining as the objective: thus we can conceive of engineers taking even the more radical step of placing the engine in the rear, the passengers still farther forward, and giving the car a true airship bow. The flat V windshield may, with progress in glass technology, become curved.

The arched truss of the Airflow cars, entirely of steel, has not only given us a stronger and safer body but has actually served to reinforce the chassis. The arched truss consists of welded steel sections Since the tube is intrinsically stronger than a channel in compression, we may see the day when, following the lead of the airplane, the truss may become tubular.

The full effects of streamlining on car economy only become available when there is complete coordination between engine and driving wheels. As streamlining progresses further, we may see more speed changes added to the car or even a universal change speed device—automatic in character.

Airplane engines are still far superior to automobile engines in efficiency and lightness. We may see such laboratories as we have described introduce much higher compression ratios with greater efficiency and power as the result.

These are only a few problems suggested at random. Each and all will call for exhaustive study in the laboratory. The young men privileged to enter the Chrysler Institute of Engineering will never cease to find fresh fields to conquer!

Books SELECTED BY THE EDITORS

HIGH COMMAND IN THE WORLD WAR

By William Dilworth Puleston, Captain, U. S. Navy

THIS author needs no introduction to our readers since he is on our editorial staff and has contributed numerous studies and discussions of military questions to our pages during recent years. Many of our readers know him also through his earlier book, "The Dardanelles Expedition," which is a standard work on the Gallipoli campaign.

Regarding the present work, we might lay ourselves open to accusations of bias were we to express ourselves fully. Suffice it to say, therefore, that in these 317 pages Captain Puleston has so correlated and compared facts—beginning with the basic causes of the war, the diplomacy leading up to it, European preparations and mobilization, and carrying through the many harrowing phases in both major and minor theaters to the armistice and a long final chapter "Conclusions and Reflections"—that we get a well-rounded picture of the war as a whole, especial attention being paid throughout to personalities and their influence on the course of the war. It abounds in studies of motives and impulses.

We endorse Colonel P. P. Bishop's comments: ". . . no one better able to present the lessons of the World War to the general reading public. . . . This book will be of exceptional interest to the military man . . . entertaining and enlightening to the civilian really interested in evaluating the accomplishments as well as the mistakes of the leaders, both civilian and military, in the World War."—$3.20 postpaid—*F. D. McH.*

SEEING AND HUMAN WELFARE

By Matthew Luckiesh, D. Sc.

IN this, the latest of 17 books written by the Director of the Lighting Research Laboratory of the General Electric Company, we are told about the new science of seeing, the main theme being that we do not even yet provide nearly enough illumination for reading, studying, working, and even ordinary living. It is a book written especially for oculists, optometrists, lighting specialists, architects, decorators, and the producers of eye-glasses, lighting equipment, paint, paper, and printing; also for the average man who may wish to keep up with the advances of science.—$2.65 postpaid.—*A. G. I.*

AMERICAN INVENTORS

By C. J. Hylander

A SMALL book of inventors is highly desirable. The present volume deals with 19 inventors of greater or lesser caliber, including Benjamin Franklin, John Fitch, John and Robert Stevens, Robert Fulton, and Cyrus McCormick, and ends with C. Francis Jenkins and Lee de Forest. The drawings are perfectly clear and the number of titles is quite considerable.—$2.20 postpaid.—*A. A. H.*

HISTORY OF THE BREWING INDUSTRY AND BREWING SCIENCE IN AMERICA

Begun by the late John P. Arnold. Completed by Frank Penman.

AFTER the hiatus in the literature of the brewing and distilling industry for so many years, it is interesting to note that the pioneers of American brewing science, John E. Siebel and Anton Schwarz, were given a memorial in the Hall of Science of the Century of Progress International Exposition on the 28th day of September, 1933. The brewing trade has been resurrected and this book gives the best history of brewing from 1630 on.—$3.25 postpaid.—*A. A. H.*

THE ANCESTRY OF THE LONG-LIVED

By Raymond and Ruth De Witt Pearl

WHY do some of us live to be old, while others die younger? Has science an answer? Once people said that it was simply because of the way we live, but this explanation bears investigation poorly. Some scientists have said guardedly (and some popular writers too positively) that longevity was a true Mendelian inherited character, passed to us before birth. The Pearls, of Johns Hopkins University, noted scientific investigators, have studied the question analytically, and the answer comes out in their book that heredity is an important factor but that, in final analysis, science does not yet know why we are or are not long-lived. This book is recommended to the serious student of biology and statistical analysis. As the authors state, it will be slow reading, because it is a serious study. Anyway, it avoids the kind of unscientific assumptions, guesses, and mere "opinions" which have heretofore bedeviled this problem.—$3.15 postpaid. —*A. G. I.*

THE MYSTERIES OF THE ATOM

By H. A. Wilson, Prof. Physics, Rice Institute

THIS is an elementary textbook of modern atomic physics—not a lengthy one but compact (111 pages) and meaty. It is not light because elementary but is full of solid substance for study rather than amusement. It contains a little high school mathematics.—$2.70 postpaid.—*A. G. I.*

ATTENDING MARVELS, A PATAGONIAN JOURNAL

By George Gaylord Simpson

THE author of this narrative is a paleontologist on the staff of the American Museum of Natural History and his book takes the reader with him on a fossil-hunting trip in Patagonia. It is a popular narrative, the purely technical and paleontological parts being published elsewhere. The author banged and bumped around in roughneck Patagonia with an old truck and with a tent, for seven months, taking whatever came, and evidently he could take it. We didn't intend to read all of this book but it read itself, for the vertebrate paleontologist who wrote it is no fossil; he can write a better, more readable, rattling good narrative than most professional writers, and he has a fine sense of humor to boot. If you want a glimpse into the adventurous life of the average flea-bitten fossil hunter in the field, here it is. Fossil hunting in Patagonia is no sinecure for mollycoddles.—$3.20 postpaid.—*A. G. I.*

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COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

De Forest Wins "Feed-Back" Patent Suit

AFTER years of litigation in various courts, Dr. Lee de Forest's claim to the invention of the "feed-back" and oscillating vacuum tube circuits has been upheld by the Supreme Court of the United States. This decision reverses that of the Circuit Court of Appeals and affirms that of the District Court in which the matter had previously been argued.

The suit in the Supreme Court was brought by Radio Corporation of America, American Telephone and Telegraph Company, and De Forest Radio Company, petitioners, against Radio Engineering Laboratories, Inc., respondent. The petitioners are assignees of patents 1507016 and 1507017, issued to de Forest in 1924; the respondent of patent 1113149.

The suit was brought for infringement of the de Forest patents, the respondent, defendant in the trial court, admitting infringement if the validity of the patents could be sustained, but maintaining that these patents are void in that they were issued to a patentee who was not the first inventor.

In the decision upholding the de Forest patents, adjudging Lee de Forest to be the first in this important vacuum tube work, the Supreme Court, after mentioning the development of the vacuum by Fleming and de Forest, made the following statements:

"Many experiments were made with a view to exploring its capacities and developing them. Among those interested and curious was Armstrong, then a very young man, a student in the school of electrical engineering at Columbia University. He conceived the idea about January, 1913, that through a hook-up or coupling of the output and the input circuit there would be a feed-back or regeneration of energy whereby the plate in the audion would become an independent generator of continuous oscillations. . . .

"It was a brilliant conception, but another creative mind, working independently, had developed it before in designs and apparatus till then unknown to the art. De Forest with his assistant Van Etten had been working during the summer of 1912 along two lines of thought. One was the use of the audion as a telephone repeater to amplify weak telephone currents and thus facilitate the transmission of long distance messages. The other was its development as a generator of alternating currents for any and all uses, some perhaps indefinite, that were capable of being served by oscillations thus produced. On August 6, 1912, a diagram showing a feed-back hook up of the input and output circuits is recorded in Van Etten's note book with a note that by the use of the coupling 'a beautiful clear tone' had been developed, which means that oscillations had been produced and that the oscillations were sustained. . . .

"Armstrong does not deny that all this was done just as stated by de Forest. Indeed the authenticity of the note book entries has never been disputed through the many phases of the controversy. What Armstrong does deny is that anything done or recorded in August, 1912, is an anticipation of his own invention. He says that the sustained oscillations generated at that time were of audio and not of radio frequency, and this, it seems, is admitted. He says there was then no perception or thought that the audion plate could be made to oscillate at radio as well as audible frequencies through a coupling of the circuits. This de Forest denies. He maintains, with the backing of other witnesses, that upon discovering the effect of the feed-back in generating sustained oscillations of the plate, he understood at once that by controlling the inductance or capacity in the oscillating circuit he could also control the frequency."

A petition for a rehearing of this case has been filed.

Corn Cure Trade Mark

IN *ex parte* Hygiene Products Corporation, First Assistant Commissioner Spencer held that the company, of Union City, New Jersey, is not entitled to register, under the Act of 1905, as a trade mark for corn, bunion, and callous plasters, the word "Relief."

The ground of the decision is that the mark is merely descriptive of the goods.

In his decision, after referring to the prohibition in section 5 of the 1905 Act against the registration of descriptive words, the First Assistant Commissioner said:

"In the case at bar, the term 'Relief,' although it may not be descriptive of the goods themselves, is believed to be clearly descriptive of the 'character or quality' of such goods. As pointed out by the Examiner: 'One suffering from corns seeks earnestly for relief. When he sees the hopeful word written across the face of applicant's bottle his only fear is that it *may not* be truly descriptive of the goods.'"

NRA and Monopolies

"PRICE fixing is, however, not the only evidence or weapon of monopoly. Control of natural resources, control of patents, control of credits—are examples of economic powers that may be exerted to crush small enterprises and subject the consumer to unreasonable prices. It should not be assumed that the NRA has a mandate or has the power to destroy monopolies and all monopolistic practices. It is our obligation not to permit or to foster monopolies by provisions written into Codes. But the NRA cannot rewrite the patent laws, or transfer control of natural resources, or direct the operations of the banks—in order to curtail the economic powers of big business institutions. Nor should we be expected to decline to consider codes presented by those truly representative of an industry because they possess economic powers which have been, or may be abused. If these are sanctioned by law, we cannot annul them. If they are held or used in violation of the anti-trust laws, their possessors obtain no immunity from prosecution merely by joining in a Code."—*From an address by Donald R. Richberg, General Counsel, NRA.*

Government Wins Case on Fruit-Washing Patent

A DECISION of great economic importance to fruit and vegetable growers of the United States was made recently by the United States Court of Customs and Patent Appeals when it awarded priority to Arthur M. Henry of the United States Department of Agriculture on a public service patent covering a process for removal of poisonous spray residues from fruits and vegetables. The decision comes after nearly seven years of litigation in which Ernest M. Brogden and Miles L. Trowbridge of California claimed prior invention of the process.

The process covered by the Henry patent consists essentially in the removal of spray residues containing such poisons as arsenic and lead by washing the fruit or vegetables with dilute alkali and acid solutions, followed by rinsing and drying. It takes the place of the old wiping methods.

Can Opener Misrepresented

EXAGGERATED sales representations are charged by the Federal Trade Commission in a complaint just issued against Scientific Products, Inc., of St. Louis, manufacturer of the "Nu-Way Magnetic Can Opener."

Using a purported picture of other companies' can openers in operation, this company, according to the complaint, advertised that "it has now been proved that ordinary can openers shave off sharp, jagged metal slivers that drop into the food contents." The picture also contained a magnifying glass showing what appeared to be particles of metal from cans opened with other companies' can openers. Under this picture appeared the statement "Actual unretouched microscopic photograph showing the many metal slivers shaved off by many ordinary can openers."

The Commission said the company's product does not prevent the falling of metal particles, "if any there be, into the food content of cans opened with said device." Representations of the alleged danger that may result from use of other can openers are "exaggerated in respect to the alleged danger or hazard. . . ."

Certain can openers made by the respondent's competitors are said to deposit smaller amounts of metal particles in the can than the "Nu-Way" itself.

SCIENTIFIC AMERICAN ADVERTISERS

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CONTENTS · SEPTEMBER · 1934

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ACROSS THE EDITOR'S DESK

"UNCLE SAM, Ace Detective" may sound like the title of a best-seller murder mystery, but in reality it is the title of a serious article scheduled for early publication in SCIENTIFIC AMERICAN. No whit less thrilling than the product of the pen of a master fiction writer, it records the success of a criminal identification system which has been operating for the past ten years in this country. While the system of finger-print identification is far older than this, the obstacles to nation-wide adoption of it in the United States have been great. It took the genius of J. Edgar Hoover, successor to the famous William J. Burns as Chief of the Division of Investigation, to overcome these obstacles and produce a system of identification that is a rapidly growing bogey to crime. If you are one of those who look upon Scotland Yard and other foreign detective systems as being superior to anything available in the United States, you are going to be agreeably surprised when you read this article. It is one of the best we have ever published on the science of criminal identification.

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THAT there are two sides to every question is never more clearly shown than when the question of tariffs and nationalism is discussed. The two main political parties in this country have argued bitterly for generations on free trade *versus* protective tariffs. So closely is foreign trade and its ramifications linked with industrial, and hence scientific, developments that we have arranged with the Hon. James W. Gerard, Chairman of the Committee for America Self-Contained, to present the arguments for making the United States virtually independent of foreign countries for our industrial and social needs. Mr. Gerard's article will be presented next month, and will be followed at a later date by another article prepared by an equally famous economist, who will present the other side. No matter what your political leanings may be, or in what light you may regard the questions of nationalism and foreign trade, these articles will prove to be thought-stimulating and informative.

ALTHOUGH SCIENTIFIC AMERICAN has published many articles on various phases of the construction of Boulder Dam, one of the best that it has been our editorial privilege to accept is now in hand, ready for publication. Prepared by R. G. Skerrett, well-known writer on engineering subjects, the article gives a résumé of the entire project, and then goes on to discuss in complete but non-technical detail the huge steel tubes that will conduct the impounded water from the 115-mile long reservoir to the gigantic turbines in the power house, or to the course of the river below the dam.

COMING SOON

¶ "Uncle Sam, Ace Detective." An intriguing account of the criminal identification system under the direction of J. Edgar Hoover.

¶ "America Must be Self-Contained," by James W. Gerard. A plea for the protection of American industries and working men.

¶ Interesting details of progress at Boulder Dam.

¶ The views of the opponents to human sterilization, by Ignatius W. Cox, S.J., Ph.D.

¶ "Wings Over Water," by Reginald M. Cleveland. Water-going aircraft are opening new phases of transportation.

¶ Meet the widow, in an article on the poisonous black widow spider.

●

THREE articles on the subject of human eugenic sterilization have been published in these pages, giving a broad view of the subject in its economic and social aspects. There is, however, a large group for various reasons opposed to sterilization, and we have asked the Reverend Ignatius W. Cox, S.J., Ph.D., to give these opposing views. Those who are familiar with the forceful writing of Father Cox need no further hint; to those who are not, we can only say that they will miss a rare treat if they miss Father Cox's article, to be published soon.

●

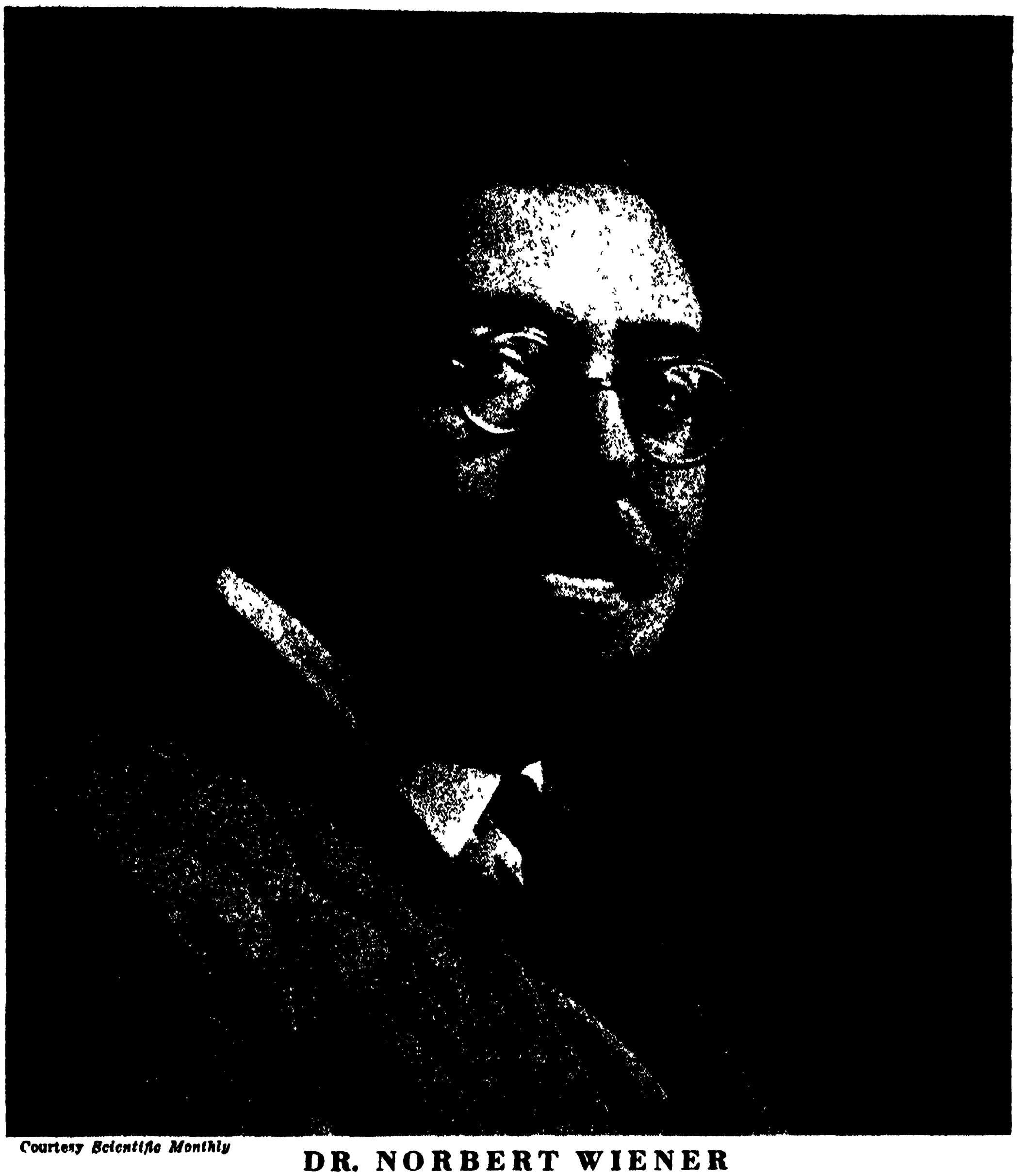
"BETWEEN a large majority of the key cities of the United States more and better landing fields are provided by natural bodies of water than by either man-made or natural airports on land. . . ." Thus, in a nut-shell, is given the gist of the reason behind the article "Wings Over Water," by Reginald M. Cleveland, scheduled for publication next month. One of the significant recent developments in water-going aircraft transportation is the commuting service between Long Island and New York City which has been made possible by the construction of suitable terminal arrangements in the East River and the use of seaplanes. That water-going planes are receiving the closest attention of technical experts is brought out in Mr. Cleveland's article to be published soon.

●

THERE are "hundreds, and probably thousands of cases of spider bite yearly in the United States. Nearly 400 cases of black widow poisoning were actually reported, 20 cases being seen in a Los Angeles hospital in the past year." This statement, made by a California physician, is quoted in an article on the black widow spider, scheduled for early publication. Although the author of this article considers the statement to be "a bit exaggerated," it serves to show that there is a definite danger from the bite of this little-known spider, one of two species in this country which may be considered as really poisonous. We invite you to "meet the widow" in an early issue, and learn something of her habits. Though she is a widow, her husband is also present, but as is so often the case in human society, her husband is only Mr. Widow.

Orson D. Munn

Editor and Publisher



Courtesy Scientific Monthly

DR. NORBERT WIENER

DO unusually precocious children later "crack up" and become mediocrities, as is commonly said? An unprejudiced examination of the evidence provides no justification for such statements--indeed, it provides plenty of justification for the statement that most such persons retain the same outstanding ability all their lives.

In 1909 a very youthful student named Norbert Wiener, the son of a Harvard professor, graduated from Tufts College when but 15 years of age. A year later the freshmen students just entering Cornell University at the normal age of 18 found there this youth of 16, already doing *graduate* work. In his studies, he was just seven years ahead of the normal age. A great deal was written about him in the press, and it was predicted that before many years he would "peter out." Instead, he became a professor of mathematics at the Massachusetts Institute of Technology, always doing brilliant work. Now he has been elected to membership in the National Academy of Sciences.

But the National Academy of Sciences is not the place to look for anyone who has "cracked up." Instead, it is a select body of America's very ablest men of science, chosen solely on a basis of proved ability and actual accomplishment. Election to its membership is the highest earned honor in American science, which fewer than 500 living scientists have won.

Courtesy *The Grace Log*

THE GREAT CHIMU FORTRESS OF PARAMONGA, IN PERU

PREVIOUS to the discovery of America by the Europeans, there was a large and powerful nation of Indians on the Peruvian coast, named the Chimu. Inland, in the mountains, were the Incas, always warlike. About the year 1400 the Incas defeated the Chimu at the great Chimu fortress of Paramonga, shown above, pursued them to their capital of Chan Chan and starved them into submission, later exterminating them. The Chimu are thought to have been an offshoot of the Mayas. The fortress of Paramonga was constructed of adobe bricks, plastered over. As the climate is dry, it remains in an excellent state of preservation today.

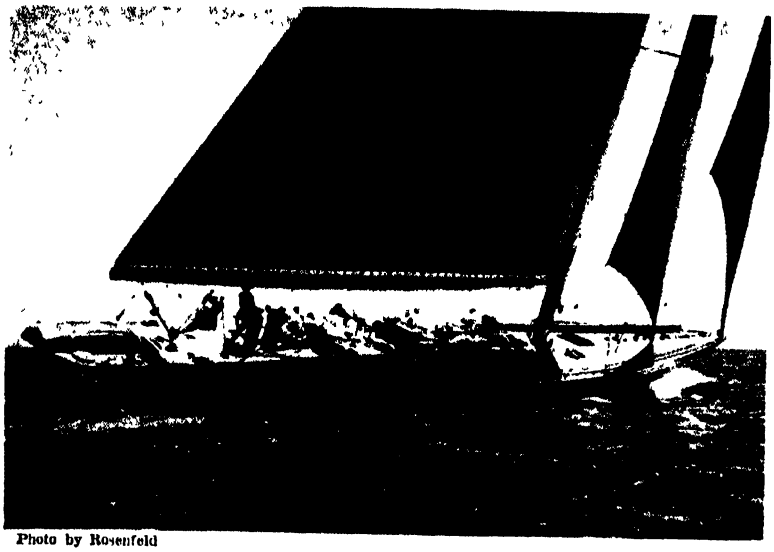


Photo by Rosenfeld

Rainbow under sail in one of the Cup defender trials. All labor-saving devices are on deck, as required by new rules of the America's Cup Race

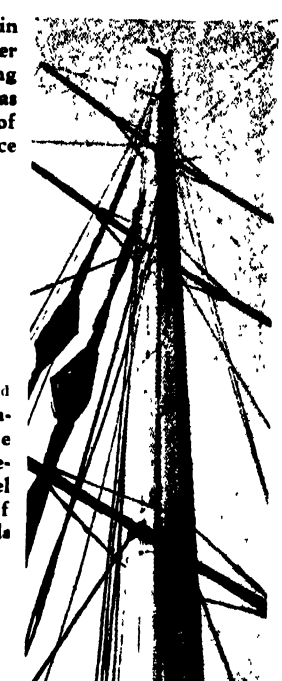


Photo by Rosenfeld

Looking up the duralumin mast of *Rainbow* to the new masthead fitting described in the text. Steel rods are used instead of the usual wire shrouds

In Defense of the AMERICA'S CUP

By HERBERT L. STONE
Editor of *Yachting*

THE America's Cup, in the 83 years it has been an object of international competition, has become the symbol of supremacy under sail. It is, perhaps, the most important sporting trophy in the world open to international competition. On its successful defense, in 14 attempts to capture it since 1870, untold millions have been spent, and into the challenging and defending yachts have gone the best brains and engineering skill of the countries involved. In the desire to attain the ultimate in speed in sailing yachts it is not to be wondered, therefore, that in a mechanical age the boats built to challenge or defend should have become mechanized to an extent that would have caused sailors of the old school of beef and brawn to blush with shame and wonder what ships and men were coming to!

Certainly the yachts of today are a far cry from the gallant little schooner *America* that sailed across the Atlantic in 1851 and met and defeated a fleet of 14 British yachts in a race of 53 nautical miles. Quite different, also, they are in hull form and rig from the sturdy, able yachts of the seventies and eighties of the last century, to which a race for the America's Cup was but an incident in a long yachting career. Yet the present Cup yachts merely follow the trend of yacht design of the period, as did the older yachts just referred to, with, perhaps, somewhat greater attention paid to details of rig and construction to make them the "last word" in yacht designing. And when once afloat, and in the hands of those who have to sail them, the same skill, seamanship, and nerve are required to get the speed out of the fabric of hull, spars, and sails, as in the days of wooden ships and iron men, to which we like to hark back. In fact, the modern sailing yacht is a much more sensitive and delicate thing to handle than the older, heavier, and perhaps clumsier, yachts of half a century ago, and a higher degree of skill in helmsmanship, sail trimming, and conditioning—or tuning up, as it is called—is required to get the most out of it.

The theory of aerodynamics is better understood today than it was in the past, and is more and more being applied to yacht design (especially in the rig) and handling. Science is supplanting tradition, which has always been strong in seafaring men to whom the tried was always the best and who looked askance at anything new. This application of scientific principles has resulted in greater speeds for a given sail area and size of hull, so that we see 80-foot waterline yachts with 7500 square feet of sail, equaling the speed over a given course made 30 years ago by 90-foot waterline yachts with over double the sail area. In the trial races of four years ago to pick a defender to meet Sir Thomas Lipton's last challenger, *Shamrock V*, both *Yankee* and *Enterprise* broke the record for a 30-mile course, and bettered the time of *Columbia* (1901), which carried nearly twice the amount of sail. On the day this was done, sailing in a 25-mile breeze, a speed of about 10¾ knots was made for the course, ten miles of which was to windward, while the reaching leg (10 nautical miles) was sailed at a speed of close to 13½ knots.

WHEN a challenge for a race for the Cup this summer was received late last fall from the Royal Yacht Squadron, on behalf of Mr. Thomas O. M. Sopwith, we were caught somewhat unprepared. It is true that we had the four Cup yachts that raced in 1930, but only one of these, *Weetamoe*, had been altered to fit the change in the measurement rule made after that race, and it was thought that the last defender, *Enterprise*, could not be altered to conform to the new conditions without slowing her up. The other two, *Yankee* and *Whirlwind*, had not shown winning form when last in commission. Also, four years had rolled by and the new

challenger, *Endeavour*, was sure to reflect any advance in design under the rule that had been made in that time. So we had to have at least one new yacht. But in the uncertain economic situation, the half-million or so necessary to finance just one new defender was hard to raise. However, Harold S. Vanderbilt, who organized the *Enterprise* syndicate in 1930, tackled the job and succeeded in getting a group together to build a new yacht. The result is *Rainbow*, designed by W. Starling Burgess, of the firm of Burgess & Donaldson, who turned out *Enterprise* for the 1930 defense.

In addition to this new yacht, the *Yankee*, owned by a Boston syndicate, has been brought out and some radical changes made in her, which include a new bow and more sail area, intended to make her a faster boat in light and moderate weather, in which conditions she did not perform so well four years ago.

Weetamoe was also altered radically by changing the shape of her keel and recasting her lead so as to lower the center of gravity of this ballast about two feet. *Weetamoe* was tender before, and this change will increase her stability about 27 percent so that she will be able to carry her sail better in a breeze. In her early trials this summer she was a much stiffer boat than before. She also has a new duralumin mast that should prove much stiffer than the old one.

ANOTHER trial horse has been fitted out this year, *Vanitie*, owned by Gerard Lambert, and built in 1914 as one of the Cup defense candidates that year. But as she does not rate in Class J (76 feet) she is not eligible to defend, although she should prove most valuable in the observation races, as she is, perhaps, the most consistent light weather yacht in the United States.

The chief interest, of course, centers in the new yacht, which is being sailed by Harold S. Vanderbilt, who did such a good job as skipper of *Enterprise* in the last match, with C. Sherman Hoyt, John Parkinson, and designer Burgess in the afterguard. As the rule under which the yachts are designed more or less controls the dimensions, through the sail area, *Rainbow* is about the same size as her competitors, but is some two feet longer on the water and six feet more over all than Burgess's former defender, *Enterprise*. Here are the comparative dimensions of the three American candidates, and of the challenger:

	Rainbow	Weetamoe	Yankee	Endeavour
L O A	126.65′	125.9′	126.0′	130.0′
L W L	82.0′	83.0′	83.0′	83.0′
Beam, extreme	20.92′	20.3′	22.6′	22.0′
Draft, without centerboard	14.9′	15.0′	15.0′	15.0′
Displacement, tons	138.13	143.0	145.0	143.0
Sail area, measured, sq ft	7555	7580	7550	7550

Rainbow is built of bronze plating below water and steel above, the seams being flush below the waterline to give a smooth finish; while above, the steel plating is lapped at the seams, making a very strong form of construction. In order to get a somewhat wider deck to work on forward, and to make for a drier boat in a sea, the forward sections above the waterline show considerable flare, something not often seen in a sailing yacht, though it is quite common in power boats.

THE last defender, *Enterprise*, was dubbed the mechanical yacht because of the many winches and other labor saving devices aboard her, mostly below decks. In fact, about half her crew worked below when she was under sail, winding up or easing off winches to trim the sheets, set halliards, and so on. Considerable mystery seems to have attached to these features, and the impression prevailed abroad that she was more of a machine shop than a yacht. But this was not really the case. For many years capstans, winches, and drums for halliards have been used in sailing vessels. In the case of *Enterprise*, these winches were located below deck where they would be out of the way, as it had become the practice not to house the crew aboard our modern Cup yachts. But the challenger, *Shamrock V*, did not have all these contrivances, and so *Enterprise* was criticized for using winches with which a couple of men could take in on a sheet, instead of calling upon all hands on deck.

The result of this criticism had one good effect. It brought about a change in the rule which made it necessary to provide full living accommodations for the crew on the yacht. The old practice was carrying things too far, when a 125-foot yacht could not house the men needed to sail her. So now all winches, capstans, shroud turnbuckles, and other labor-saving devices must be on deck; and bulkheads, berths, cooking, and mess gear must be fitted below, as in any yacht used for cruising. *Rainbow* is so fitted, and her deck is not too greatly encumbered by the sheet and halliard handling devices.

Perhaps the greatest engineering feat in the construction of the new boat is her mast and the manner of staying it. This mast is of duralumin, and is some 165 feet in length. It is pear shaped in section, being about 30 inches in diameter, fore and aft, by 18 inches the other way. It was made by the Glenn L. Martin Company, airplane manufacturers, and in its construction over 19,000 dural rivets were used. It is not as light as the dural mast of *Enterprise*, four years ago, but the rule now calls for a minimum weight of 5500 pounds. This new stick is about 160 pounds over that weight, but more weight has been saved

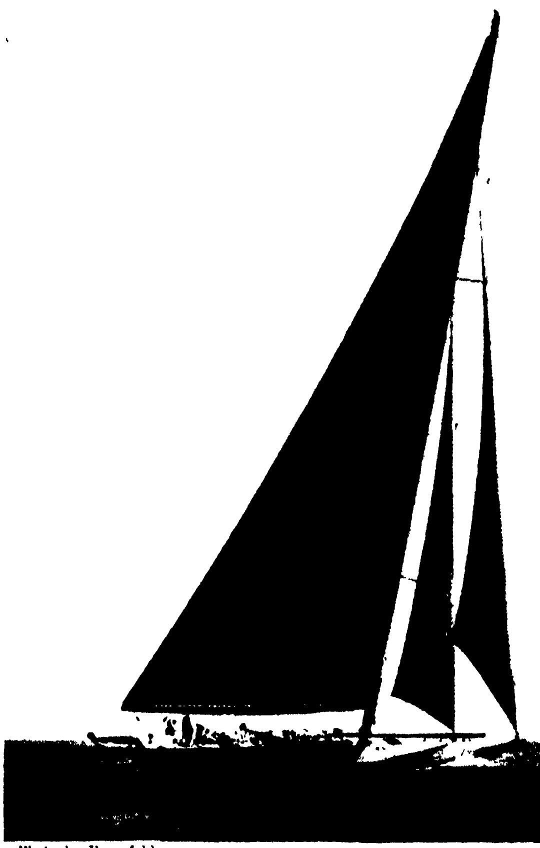


Photo by Rosenfeld

Rainbow

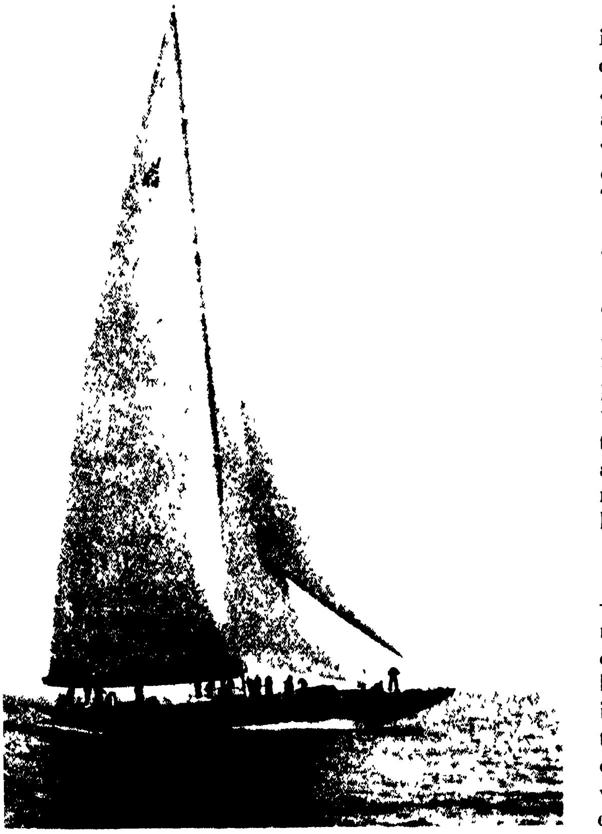
in the metal mast fittings required on a wooden mast of the same weight.

At the top of the mast is the sheave, or roller, which carries the main halliard, the hauling part of which comes down through the center of the hollow spar. Surmounting this is a masthead fitting carrying the eye for the backstay and a special sliphook which engages an eye on the headboard of the mainsail and thus carries the weight of the sail when it is hoisted, taking all strain off the halliard and lessening the compression on the mast due to the downward pull of both sail and halliard. When lowering, the sliphook is disengaged by a trip line, letting the halliard again take the weight of the sail.

The radical feature of the staying of this tall mast on a narrow hull which allows a spread to the stays of only 21 feet (or less than 10 feet on each side of the mast) is the use of steel rods instead of the usual wire shrouds, several of which are required on each side. These rods, which are of special steel having a high tensile strength of 215,000

pounds to the inch, are in lengths of 27 feet, or less, and are joined together by threaded turnbuckles or unions, by means of which the slack is taken up and the shrouds adjusted to the desired tension. There are only two of these sets of shrouds on each side, the upper one leading over the ends of the three sets of spreaders, and the lower one leading from the mast at the lower set of spreaders. The largest of these rods is not over one inch in diameter, the upper ones being successively smaller in diameter as they approach the top of the mast. These rods not only hold the mast more stiffly than wire shrouds, but save both weight and windage aloft, where every pound of weight counts heavily when the boat is heeled and jumping into a sea.

In the early part of the season *Rainbow* carried a normal hollow wooden boom, but early in July it was replaced by the famous "Park Avenue" boom used by *Enterprise* in 1930. This boom is triangular in section, is hollow, and about four feet in greatest width on top. Across the top are many lateral tracks carrying slides attached to the foot of the mainsail. These allow the mainsail to take the desired curve, or arc, on the foot, conforming to the arc of the sail higher up, so as to make a true curve of the entire sail, instead of having the foot held in a straight line, obviously less efficient than the curve the sail takes in its higher and mid-sections, when filled out by the wind.



Sopwith's challenger, *Endeavour*

The British challenger, *Endeavour*, tried out in her early races a flexible boom, designed to accomplish the same object as the triangular boom just referred to. But it broke in one of *Endeavour's* trials and from last accounts the challenger is being fitted with one of these "Park Avenue" booms, which the British looked upon doubtfully four years ago.

In the case of the British challenger, we find that C. E. Nicholson, her designer, has turned out a remarkably fine yacht, and one that, in the capable hands of "Tom" Sopwith, is likely to prove the most formidable threat that we have had to meet in many years. No expense has been spared to make her the fastest yacht of her class in British waters, and she embodies just as many radical features as our new yacht. Sopwith, being an airplane manufacturer, has used his knowledge of light construction combined with strength in the fitting for her rig, and all her gear is thoroughly up to date.

Endeavour is built of steel instead of bronze, and the underwater plates are laid flush, as in the case of *Rainbow*, and are riveted through on steel strips covering the seam on the inside, and caulked. These plates are specially prepared to prevent rust or scaling, and the bottom is polished to a fine surface, equal to that of the bronze American Cup yachts. The mast is also of steel, the plates being electrically welded and strengthened internally by light steel diaphragms, following nature's method of strengthening bamboo.

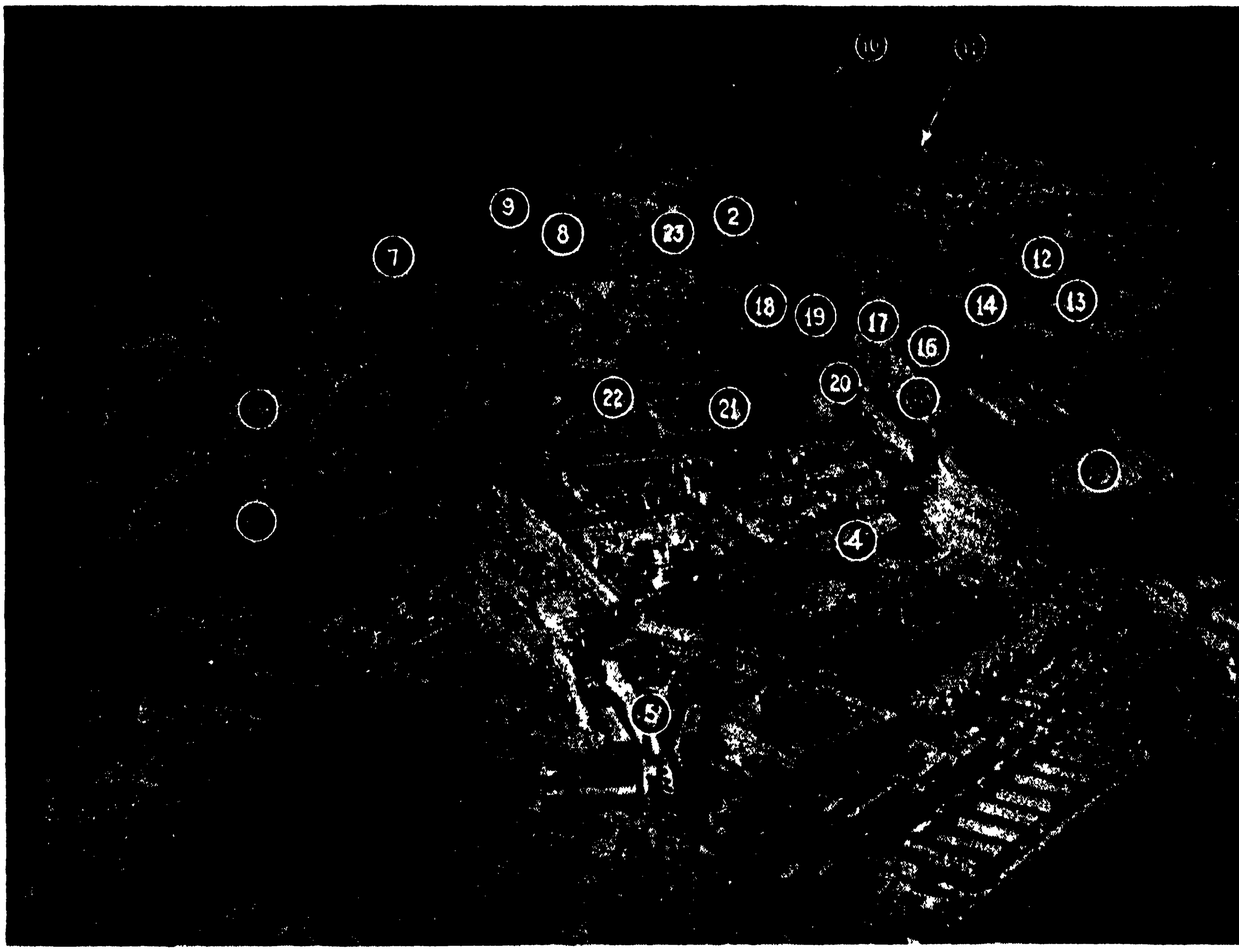
AGAIN calling upon the knowledge of aerodynamics acquired in airplane development, the challenger has done much experimenting with model sails in wind tunnels to discover the most efficient combinations of the various sails in *Endeavour's* equipment. Known as a clever helmsman and skilful sailor, Mr. Sopwith can be counted on to give us a real race. He will, of course, be sailing in strange waters, which is always a disadvantage, but his boat has been carefully designed, she is well organized, and will probably be well handled throughout her campaign. *Endeavour* has been successful in her races in British waters, and while her margin of superiority over last year's *Velsheda*, and the other yachts of her class, has not been great, she has won perhaps four fifths of the races in which she has started She is undoubtedly the best all-around yacht of her class in Great Britain.

On this side of the water, the three Cup contenders are in the midst of a hot campaign as this is written. It is still too early to predict the choice of a defender by the America's Cup Committee. *Rainbow* has won more races than either of her rivals, but she was the first one to get under sail, and her crew have had a longer time to get her shaken down and into proper trim. But, to offset this, she has not shown outstanding form up to mid-July. In a strong wind, the larger, more powerful *Yankee* still seems the best of the trio, and she is being well sailed by Charles Francis Adams, of Boston. In moderate sailing breezes the three yachts are closely matched, with *Rainbow* holding a good "edge," although the new yacht and *Yankee* had met in only a few races up to mid-season.

THE final decision looks as if it might be a close one, with the ultimate choice depending on handling and organization. If it comes down to this, it seems as if the Vanderbilt sloop would be the logical choice. The real test will come in August, when all the yachts have been thoroughly conditioned and will meet in the actual series of trial races. But on whichever yacht the call to defend is finally made, we may rest assured that ship and crew will give their best. Whether this best will be good enough to turn back the challenger, as our yachts have done in 14 other contests since 1870, only the series beginning off Newport September 15th, and continuing until one boat has won four races, will show. May the best sailed yacht win is the wish of all real sailormen and sportsmen.

•

Up to July 18th (when this is written) Yankee, *the Boston yacht, had much the best of the argument. In six trials against* Rainbow, Yankee *won five races, although she was disqualified in one of these for fouling* Rainbow *at the start. Against* Weetamoe, *the Boston cutter won all of the four races in which these two met.* Rainbow *has also been successful against* Weetamoe, *winning four of the first five in which this pair started. Against* Vanitie, Rainbow *won all of the three races in which they have met, while* Yankee *won once and lost once to* Vanitie *in the two trials in which they have been paired. Practically all of these races were sailed in light to moderate winds. What will happen when these four contenders meet in a strong breeze has yet to be determined in the further trial runs.*—The Editor.



This model in clay presents the salient features of old Rome before Mussolini's archeological discoveries

Plastic Model of Ancient Rome

ROME has always lent itself to pictorial representation; now the ancient city has been reproduced in modeling clay. Through the co-operation of the Italian Information Office, in New York, we were able to secure the assistance of a prominent Italian scholar who is thoroughly familiar with Rome and the extensive work that is being carried on there. Dr. John F. Gummere, of the William Penn Charter School of Philadelphia, placed the numbers on the photograph of the clay model, reproduced above, and indicated where important archeological investigations have taken place, or are in progress.

At 1 is the Circus Maximus, which was 2000 feet long and 400 feet wide and held 125,000 people. The excavations begun in 1928 involved the demolition of the buildings encumbering the area. At 2 is the Circus Flaminius.

The Colosseum or Flavian Amphitheater, shown at 3, is one of the best known landmarks in Rome but is now a sorry wreck as the result of earthquakes as well as of greed for stone. The Colosseum took the place of the Circus Maximus, but the accommodations were smaller; the elliptical structure is 640 feet long at the major axis and 500 feet at the minor axis; 45,000 spectators could be seated and 5000 could stand on the roof. A magnificent road has been built by "Il Duce" to connect the Colosseum and the Victor Emmanuel Monument. This is one of the wonders of the new Rome.

NUMBER 4 is the Temple of Claudius, and number 5 is the immense Claudian Aqueduct which in its entirety was over 41 miles long. Number 6 is a colonnaded edifice called the "Septizonium," rounding off the view from the Via Appia, which ended here. Number 7 is the Island in the Tiber which contains the Temple of Aesculapius. The Theater of Marcellus, at 8, has been the center of much excavation. The Theater of Balbus may be seen at 9, and the well-known Mausoleum of Hadrian, 10, has been known for centuries as the Castle of St. Angelo.

The Pantheon, with its beautiful dome will be seen at 11. The buildings in the Forum of Trajan, shown at 12, have been recently restored as has also been the Temple of Mars, 13, and the Temple of Venus, 14. The Temple of Venus and Roma served as a storage space for the machinery of the Colosseum, and will be seen at 15. At the Basilica of Constantine, 16, and the Basilica Aemilia, 17, important excavations have been made.

Following the remaining numbers, we find the Basilica Julia at 18; the Temple of Castor at 19; the Temple of Julius Caesar, 20; the Temple of Apollo, on the Palatine Hill, 21; various imperial buildings at 22; and the Temple of Jupiter at 23 on the Capitoline Hill. Some of these recent and important discoveries were illustrated in our March issue. Rome seems an ever-fresh field for the archeologist and the destruction of the slums has greatly enhanced our knowledge of Roman culture and particularly of Roman architectural remains.

OUR POINT OF VIEW

Why Science Refuses

ONCE more failure has been the result of honest attempts of men of science to "get together" with those who are interested in things psychic, and to investigate psychic phenomena as an actual branch of experimental science. Last winter the professional scientists' magazine *Nature*, published in London, commented on the lack of ordered understanding among many who delve into things psychic, and pointed out a fact which most disinterested persons already know; namely, that inquiry in this field has mainly fallen to the lot of those who wish to prove what they hope to be true.

The editor of the same journal therefore proposed the formation of a body, to be called the "International Institute of Psychical Research," which would undertake to investigate psychic phenomena according to the scientific method. This organization was soon formed under auspicious circumstances so far as science was concerned, for its president was Professor (now Sir) G. Elliot Smith, the eminent anatomist-anthropologist, and its two vice-presidents were the noted zoologists, Professors Julian Huxley and E. W. MacBride. We say "as far as science was concerned," for the psychic end that is, the other end of the investigation was represented by a Glasgow business man who had previously been characterized in *Nature* as having little conception of the critical attitude of science. The new body was therefore condemned as not satisfying the conditions of psychical research in a university or similar institution, and as a result of the difficulty of obtaining conditions for research which were in accord with what science regularly demands of the inquiries it makes, it has already died. It died aborning, in fact.

In America attempts have been made to conduct psychic investigation by the scientific method, in which there was a liaison between university scientists and typical representatives of the psychic world, but these attempts have largely failed when it came at last to be realized by the scientists that their friends on the psychic side would not play the game. The evidence is that the psychic side does not even know the rules of the game, though it apparently thinks it does. The rules of the game are the rules governing all good science, and together their faithful practice constitutes what is called the "scientific method." Few understand or fully appreciate what the scientific method is. Few sense its exacting requirements, its stern, rigorous discipline and methodology. Outside of the world of science the best analogy with the scientific method is the rules of evidence employed in the courts. If the legal rules of evidence seem hard-boiled, let the reader study those which govern the methodology of good science; for example, as outlined in the Encyclopædia Britannica under "Scientific Method," or in the noted works on the same subject by Jevons, Ritchie and others. The rules of the scientific method are the rules of logic—tough going, some of them Emotional and personal feelings, urges, motivations, and wishes, are utterly excluded when weighing the evidence. The jury knows no bias.

Until those who eagerly accept the psychic phenomena they see, as already proved, will actually take the necessary pains to learn just how exacting a thing the rules of the scientific method are, it seems likely that every future attempt to bring psychic phenomena to the scientists for an investigation will result in as quick a rejection as that which has just taken place in England. Thus far the psychic people, with some exceptions, have not been able to assimilate the scientific method, and in too many instances investigations have degenerated into a contest of wits. Science can but poorly play ball with that kind of players—like playing ball blindfolded, hobbled, and handcuffed.

That, and not narrow-minded prejudice, is why most scientists steadfastly refuse to give their time and energies to the investigation of psychic phenomena. When the psychic world makes up its mind to play the game, plenty of scientists will be found to show an interest in the scientific investigation of psychic phenomena.

Welcome, British Yachtsman

FOURTEEN times since 1870 have challengers appeared to compete for the America's Cup, supreme prize of yachtdom. The fifteenth challenger, T. O. M. Sopwith, British sportsman and airplane manufacturer, will bring his *Endeavour* to this country and compete, in September, with the ace of American yachts. To Mr. Sopwith and his crew our greetings; may fair winds and clear skies attend your efforts. If you win, you will gain much more than just a trophy. If you lose, come again. While you are here, the latch-string is out and you will find a hearty welcome from all American sportsmen.

Better Movies

THE various religious organizations which are co-operating in an attempt to "clean up" the movies are waging a commendable battle, and one which, if it does not become fanatical, as is too often the case with crusades, should have the approval of every right-minded citizen.

Science has placed in the hands of the motion-picture producers a mighty weapon for good or for evil. Technical developments in talking pictures have opened fields of entertainment and "sugar-coated" instruction that could never have been touched by the "silents." How the producers make use of these possibilities in the next year or so is going to have a marked effect on the future of the industry.

The producers defend themselves by claiming that they are giving the public what it wants in most cases vulgarity and salaciousness so thinly disguised as to escape the notice only of a moron. It hardly seems possible that the greater part of the movie-going public of the United States is mainly interested in such trash. In fact, the success of a few of the attempts at producing clean, intelligent pictures belie the defense and place the onus right where it belongs—on the shoulders of the producers who release what they, in their own minds, *think* the public wants.

This is a plea, not for pictures of the goody-goody type only, but for pictures that will insult neither the intelligence of the audience, nor their sense of what is in good taste. Sophisticated drama—of the sort that has kept the classics in vogue for generations—comedy, musical comedy, clean straightforward narrative, all offer more material for moving pictures than can ever be used. Those producers who think that the public want only gutter-English, smutty dialog, situations in which sex and sexual attractions predominate, and double meaning in all jokes, have much to learn. If they persist in pandering to the lower human element, and completely disregard those who desire intelligent entertainment, they should be drastically curbed. Perhaps the present movement will accomplish the purpose. It has our sympathy and support.

A diving helmet being lowered into place on the author's shoulders

DIVING IN

By ROY WALDO MINER
Curator, Living Invertebrates, American Museum of Natural History

THE steady hum of the engine of the *Standard J.* ceased as the bow anchor went overboard.

"Hey there, you Moxie!" shouted Captain Joe Bethell, "Haul up that dinghy! You and Sweeting carry out the other anchor and hook it over that coral in the yellow patch! Hustle 'er out now!"

Soon the graceful launch was floating close to the reef, anchored securely fore and aft. The brass rope ladder splashed into the water from the starboard gangway and I was standing on it submerged to my neck. Sweeting started one of the pumps going while Moxie carefully lowered the helmet over my head. I thrust my right arm through the loop of the air-hose.

The steady clinkety-clank of the pump sounded close to my ear as I adjusted the weight of the helmet to my shoulders and started down the ladder. The edge of the water-surface appeared momentarily through the window of the helmet and vanished upward as I passed beneath it. Immediately the weight was lifted from my shoulders and the helmet seemed as light as a feather. I counted the rungs of the ladder as I descended, marking the number of feet from the surface. I swallowed once or twice to relieve the increasing pressure on my ear drums, and at the twenty-second rung stepped off the ladder on to the white sand of the sea-bottom.

Steadying myself by grasping a ladder-rung, I looked about me. A short distance away rose the coral reef, tier on tier, to the surface. Clusters of mushroom-like coral growths formed the bulk of the reef. Purple and yellow sea-fans swayed back and forth with the motion of the water, while sea-bushes of soft and varied hue rose from slender stocks, their waving branches, extending upward in widely expanding parallel ranks, starred with hosts of feathery polyps. Caverns and arches of eroded coral, fantastic in form, showed clearly through the unbelievably transparent water or melted into the pearly blue liquid mist in the distance.

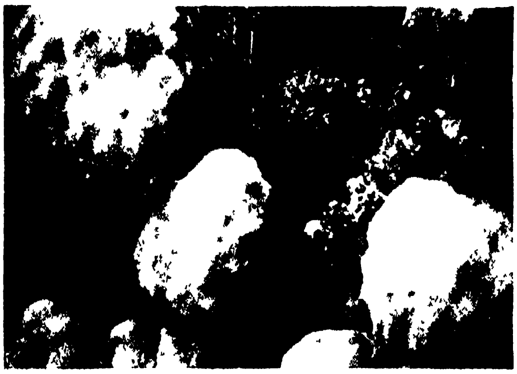
I TOOK a few steps forward, leaning against the push of the current, and glanced up. A disturbance of the water at the summit of the ladder attracted my attention. A pair of legs appeared weirdly on the rungs. The body was not visible, being concealed by the liquid mirror of the water surface. This was impenetrable to the view, but reflected an inverted image of the legs, giving the odd effect of a St. Andrew's cross! In a few minutes the rest of the figure and a helmeted head succeeded the legs, descended the ladder, and stood on the sea floor beside me. Looking through the window of the helmet, I saw the smiling features of Roswell Miller, who, with Mrs. Miller and my artist, Chris Olsen, completed the personnel of my expedition for the American Museum of Natural History.

I motioned toward the reef and we advanced slowly in the direction of an outlying brain-coral that towered above us on a fantastically carved pedestal, with a cloud of bright yellow fishes flitting around its summit like canary birds. Rounding this mass, we entered a crooked passageway which led toward one of the great overhanging arches of coral rock. As we peered within, a moving form became visible in the watery shadows, then another.

Presently, a huge parrot fish, brilliantly blue, varied with deep violet, swam slowly out of the cavern, followed by two others in stately procession. Back and forth they sailed, staring toward us, occasionally nibbling at a bit of loose coral, portions of which they crushed with their white, parrot-like beaks, releasing powdery fragments which rose in clouds as they masticated them for the filmy nourishment they afforded. We signaled to each other and edged back toward the boat. The window of a water-glass penetrated the surface beside the bottom of a floating dinghy. We motioned with our arms, and the undersea tripod splashed down through the water. The heavy underwater movie camera now came gliding down, hooked on the end of a cord.

We slowly and painfully erected the tripod, carefully adjusting it in a favorable position. One must move with deliberation at the bottom of the sea. Attempts at rapid motion were futile and exhausting, but if we moved slowly, the water supported us in half floating fashion and we progressed easily with the effect of a slow-motion film.

After the tripod was erected satisfactorily, we returned for the camera-box. I reached for it but miscalculated the distance, and my hand grasped empty water about two feet in advance of it. Distances under water are deceptive to



Several types of undersea growths photographed by Dr. Miner's expedition. *Left to right:*

CORAL GARDENS*

A Scientist Works Beneath the Clear Waters of the Coral Reefs of the Bahamas

the vision, because of the unaccustomed density. Groping forward, I felt the handle of the camera-box, and had no difficulty in lifting, with one extended hand, a weight that both hands could scarcely raise from the boat's deck, in the open air. We carried the box over to the tripod, placed it in position, and took turns pressing the lever that actuated the mechanism of the camera.

As the focus of the camera had to be set at a predetermined distance before sending it down, it was impossible to focus on a fish directly, and it was tantalizing to see beautiful queen triggers, blue angel fishes, and grotesque trumpet fishes come into plain view at a distance of 25 feet, when we had carefully arranged our focus at ten feet.

After 50 feet of motion picture film had been taken, we carried the box back to the cord which hung suspended from the launch and sent it up for Captain Bethell to rewind and return to us again. When the film had completely run out, it was sent up for Mrs. Miller to change, and a second undersea box containing color film was sent down. This was Roswell Miller's specialty, and with it he obtained beautiful motion pictures depicting the soft colors of the living corals and gorgonians and the brilliant hues of the fishes which lived among them.

Our attention was attracted by a wonderful cluster of golden yellow coral which rose in an enormous dome above our heads. It was composed of a succession of expanded mushroom-like caps, completely covered with small conical mounds which gleamed in the sunlight flickering through the ripples overhead.

*Courtesy *Natural History*

Like most such growths, the caps were supported by eroded columns of dead coral limestone overgrown with encrusting sponges of scarlet, or green and yellow. Clusters of coral grew vertically from the sides of the columns sculptured on both sides of their thin leaf-like expansions with close-set series of fine parallel ridges exquisitely wrought with radiating star-shaped calices. Hues of delicate rosy pink shaded into cream-yellow tints, suffused at intervals with areas of orange and purple

WE had brought with us specimens of this coral which had been colored artificially by our artists for use in the Coral Reef Group being constructed in the American Museum. We now took these with us down under the sea, and placed them beside the living specimens for comparison so as to test the accuracy of our colors. The result was gratifying. At arm's length, they looked exactly like the real coral and blended with their living neighbors so perfectly that they could not be told apart!

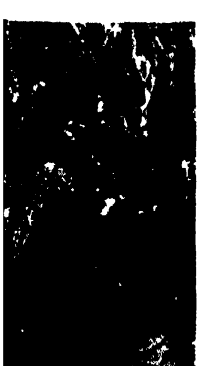
One stands amazed at the wealth of detail which gradually dawns upon the vision as the attention is directed to the multitudinous forms of which the reef is composed. Here, a magnificent purple sea-bush spreads its comb-like fronds before us. Every branch is covered with thousands of transparent cream-colored polyps each spreading eight raylike tentacles around a tiny dot of a mouth, so small that it can be seen only upon close examination. The sunlight shining through their translucent crowded bodies outlines every twig of their waving, treelike home with a multiple margin of glory.

The helmet in place, the author starts down the brass rope ladder

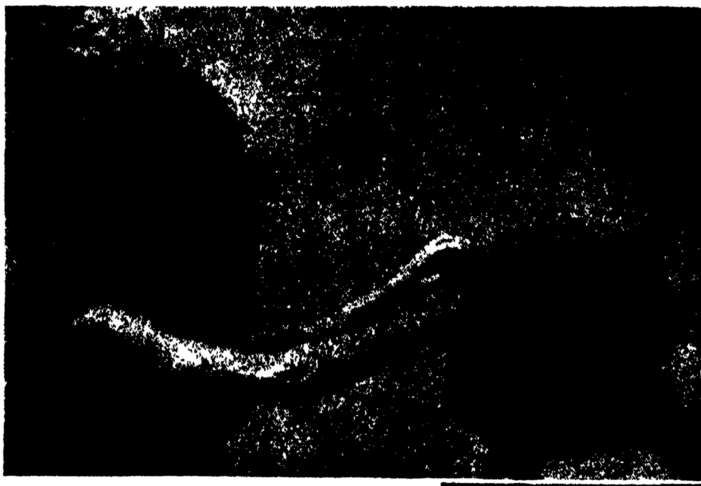
A cluster of fluffy green clubs rises from a crevice between two rounded brain-corals. The starry blanket covering them seems to be very soft and deep. I touched it with a speculative finger. The soft clubs magically transformed themselves into a cluster of hard, finger-shaped projections of bright purple! Looking closely, I saw that the fingers were covered with thousands of pin-holes, and, as I watched, one filmy form after another peered forth and gradually elongated until the purple surface of the fingers became clothed once more with fluffy green.

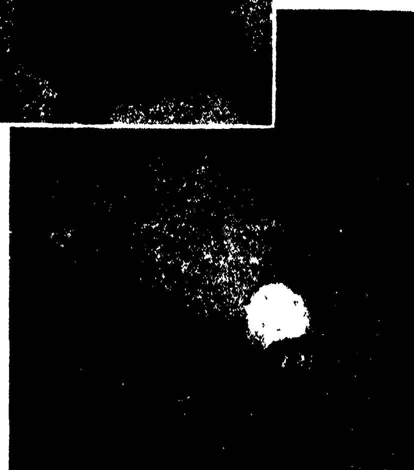
The sea-clubs, sea-bushes, sea-whips, sea-feathers, and sea-fans are all grouped together by scientists under the name *"gorgonia."* Unlike the corals, their tree-like skeletal support is flexible, being composed of a tough, horny substance invested with a crust of felted calcareous needles, irregularly shaped and of extremely small size.

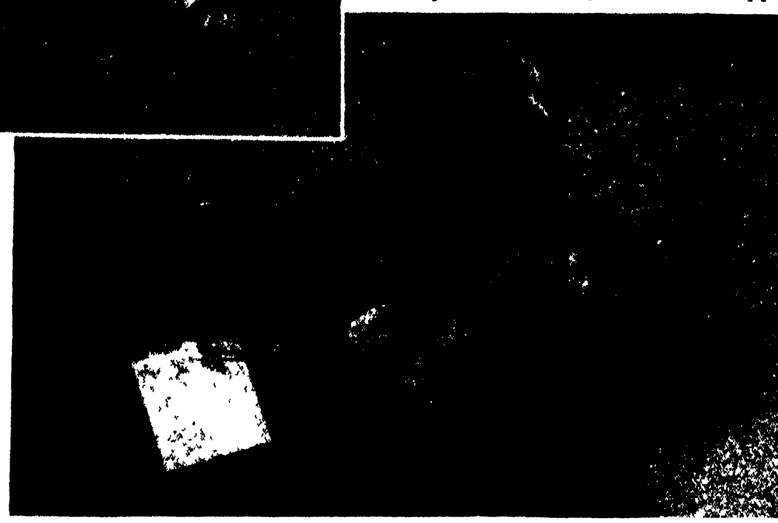
The reef-forming corals resemble the gorgonian polyps in appearance and structure except that their cylindrical polyps are surmounted by many tenta-



***Orbicella*; Elk-horns; Gorgonians among the corals; Large *Orbicella annularis*; Fan corals**







Above: **Using the special underwater movie camera described in the text.** ***Right:*** **Watching the divers through a water glass.** ***Lower right:*** **Painting under water, using a Monel-metal palette and special canvas**

cles in multiples of six, and have the power of laying down a skeletal structure of carbonate of lime beneath and around their soft bodies. The concerted action of millions of coral polyps builds up the immense and complicated limestone structures which form the coral reef. The coral skeletons may form crusts over the sea bottom, or may rise in dome-shaped masses like the brain and star corals or postlike growths capped like mushrooms, as in the case of the orb corals. They may be leaf-shaped or like rosettes, or sinuously petalled flower-like colonies. Among the most beautiful and striking corals of the Bahaman reefs are three species of *Acropora* which form branching structures, the most delicate and fragile of which is the fan coral. The staghorn coral builds loosely branching many-tined skeletons reminding one of the antlers of a stag. The largest and most massive of the three is the great elkhorn, or palmate coral which forms gigantic growths with branches like beams, expanding into broad, palmate tips. This species dominates the great Andros barrier reef, where the scene of the American Museum's Coral Reef Group is laid. All the other species of coral are found there, but are overshadowed by the great orchard-like groves of the elkhorn, which rise in tangled thickets of marble trees tinted with saffron.

DAY after day, whenever the weather permitted, the good launch *Standard J.* took us from clump to clump of the reefs at Rose Island, Athol Island, and Long Shoal. We had three undersea cameras, two for black and white motion pictures, and one for color film. The latter and one of the former were the ingenious contrivances of Roswell Miller. There were also two helmets and pumps, which thus enabled two persons to go under the sea at a time. We could walk about together and communicate by means of predetermined signs which enabled us to compare notes for our work. At times Chris Olsen would go down with palette and easel constructed of non-corrosive metal. He would set up his easel on a convenient clump and fasten into it an oiled canvas securely mounted on a sheet of plate glass. Then he would make sketches with oil colors directly from nature, undersea, at a depth of 15 or 20 feet. At first, he used the regulation artists' brushes with wooden handles, but whenever, inadvertently, he let go his hold on one, it would float to the surface and Moxie would have to row out with a dinghy to get it. Besides, in the wash of the tide, a brush is not steady enough for applying color. So Olsen finally used a palette knife instead, which was much easier to manage.

On this trip we had the pleasure of introducing to the undersea world His Excellency Sir Bede Clifford, Governor of the Bahamas, and Lady Clifford. They came down in turn and explored the face of the reef, working their way through the crevices between the coral clumps, facing the inevitable camera at a depth of 20 feet. The Bahaman officials were all greatly interested in our work, and did everything in their power to assist us.

Occasionally, when the weather was too rough for diving, we went ashore on one of the rocky cays which abound in the waters near Nassau, and, by means of hammer and hatchet, hacked off huge fragments of the eroded "honeycomb rock" of which they are composed. This rock is wrought by wave and weather into most fantastic forms; in fact, the whole surface of the cays is full of holes and passages like a petrified sponge. We obtained more than a ton of this rock and shipped it to the Museum, where we are now reproducing a portion of such a rocky cay as a part of the foreground in the upper section of the group, using the original material in the process.

This group is now nearly finished. A few months more and the exhibit will be complete, after ten years of arduous work. During that time, five expeditions have been undertaken to the Bahamas. These five expeditions have been interpolated between long periods of work at the Museum, preparing and coloring corals, erecting the elaborate framework to support them in the group, consisting of more than seven tons of structural steel (see page 216, April 1932 SCIENTIFIC AMERICAN. *Ed.*), modeling and coloring fishes and the other multitudinous forms of undersea life composing the coral reef association. When finished, it is estimated that the exhibit will be the equivalent of 30 ordinary museum groups in size and difficulty of preparation. It will occupy one third of the entire farther end of the great Hall of Ocean Life, probably the largest museum exhibition hall in the world.

600 Wheels an Hour

An Efficient Set-Up of Special Machinery and Gravity Conveyors Makes It Possible to Turn Out Motor-Car Wire Wheels at this Speed

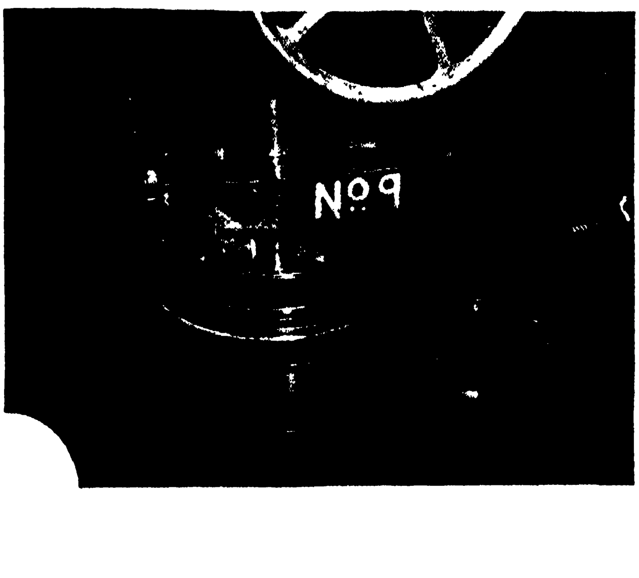
Rims are formed from steel strips flash welded at the joint and pressed to form. Machine above punches and countersinks spoke holes

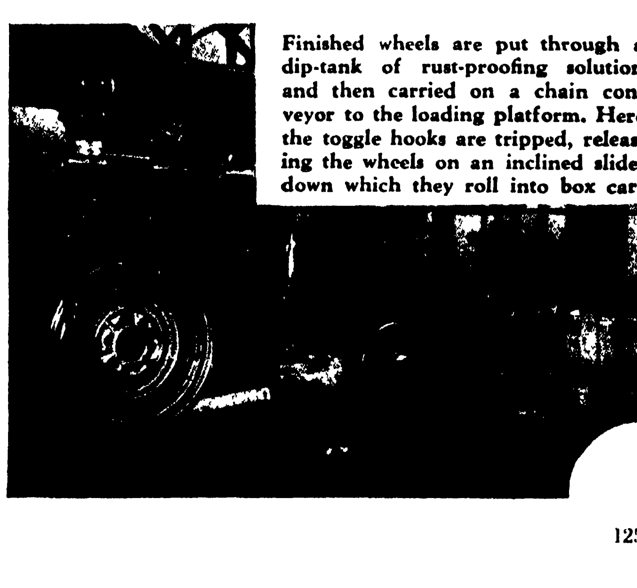
Below: Press that forms the inner hub shell. Formed shells are discharged to rear

The first operation in forming Chevrolet outer hub shells is performed in this double-geared punch press. The operator is shown inspecting a stamping. To the right of the press is a spray of lubricant directed on the strip of stock which is being automatically fed toward the machine to a point where it can be grasped by the operator. This type of inclined press speeds up operations as the work is discharged and transported by gravity to next press by means of sloping runways

Above: Spokes cut from straight wire stock are loaded into this oscillating hopper where they are joggled to bending position

Below: After the 48 spokes of the wheel are riveted in two operations which insure even tension on each spoke, the assembled wheel is placed in this semi-automatic machine where the hub and face of the hub side of the wheel are bored, while at the same time the hub face is finished from below





Finished wheels are put through a dip-tank of rust-proofing solution and then carried on a chain conveyor to the loading platform. Here the toggle hooks are tripped, releasing the wheels on an inclined slide, down which they roll into box cars

THE STERILIZATION LAW

By C. THOMALLA, M. D.

IN the new Germany today laws are being enacted which are designed to a large extent for the benefit of future generations, and usually with no regard for the approval or disapproval they may now find. In Germany all thinking and planning has as its aim the improvement of the health standards of the people, through the application of biological science. May it not be that the sufferings and sorrows of the Germany of the past, of today and tomorrow, may sooner or later become the concern of any other nation?

Germany has profited in this respect from American experiences and practices. For a number of decades 27 of the 48 American states have been establishing legislation to prevent the propagation of hereditary defects, thus interfering with the transmission of feeblemindedness, idiocy, mental disorders or pathological criminality. The German sterilization law of recent origin, however, caused an unprecedented alarm all over the world. Although the scholars as well as laymen of a great variety of nations considered it a landmark in the history of mankind, and welcomed and celebrated it as a diversion from the wrong road thus far traveled by humanity, there were groups which for various reasons characterized the German "Law for the Prevention of Hereditary Diseases in Posterity" as a return to barbarity and to the unchristian customs of the Huns. Nevertheless we Germans accept this charge, jointly with those 27 enlightened and progressive states of America, as well as with many a Swiss canton and the Scandinavian countries, and we are glad to learn of approving voices raised in such other nations as Hungary, Czechoslovakia and more recently in England—voices which urge the enactment of similar laws.

OF the many justifications which exist for sterilization laws, the most elementary and obvious ones are those in regard to cost. Take, for example, the cost of education: For each sound and healthy pupil Germany pays annually from public funds the sum of 75 Reichsmarks. For a so-called *Hilfsschulkind*—that is, a feeble-minded pupil—several times that sum is required. For an inmate in a reformatory, that is, for an asocial type, psychopathic or otherwise, it costs the German people 20 times as much. An insane person costs the state and the taxpayer from six to eight marks daily. Insane persons of criminal potentiality who require special attendance and watch in isolated quarters cost up to 20 Reichsmarks daily. The majority of the gainfully employed individuals in Germany do not earn nearly as much as the state has to pay for supporting degenerate, idiotic, criminal and insane persons. In a state which is desperately fighting for its existence, as is Germany, it is a simple problem of arithmetic whether to allow for all eternity the procreation of defectives, thereby most heavily burdening financially the working people, or whether to interfere before it is too late with the career of the worst and most costly of this kind of defectives.

ON these pages we present the third article of our series on human sterilization. This article was secured through the German Embassy at Washington, and is therefore regarded as an officially sanctioned statement of Germany's aims in connection with racial and national eugenics.

In a later number we expect to present an article by the Reverend Ignatius W. Cox, S.J., Ph.D., Professor of Philosophy at Fordham University, a Jesuit institution, and this will represent the views of those who are opposed to human eugenic sterilization.—*The Editor*

IT must be pointed out, however, that in addition to the mentally diseased, a certain group of physical defectives of a hereditary nature will also fall under the sterilization law, such as the hereditary blind and the hereditary deaf and dumb. These otherwise mentally competent persons, many of whom are frequently highly qualified, do not cause any expense to the state (excepting the costly period of their training). They are in a position to earn their own living. Nevertheless the legitimate associations of these groups themselves declared that they were in favor of this law, which, after all, is supposed to prevent the transmission of such tragic cases into future generations. The voluntary approval of the law by the associations referred to, indicates an existing appreciation for the action of the government.

The acceptance of the sterilization law, both by the government and in the opinion of the people is, however, preeminently due to the danger that in the future inferior types may numerically outbreed the higher types. Professor Lenz, who occupies the chair of race conservation in the University of Berlin, offered a hypothetical example which everyone may check with regard to its soundness. Suppose that Germany in 1630 had possessed a population of which 50 percent were white and 50 percent colored. If, then, during the last 300 years the colored population had increased by four children at intervals of 25 years, and the white population by only three children at intervals of only 30 years, then 90 percent of the people today would have been colored, and only the remaining fraction white. Substitute for colored such qualities as hereditarily weak, asocial, indolent, idiotic, incapable, and for white substitute high type, industrious, intelligent, brave, and so on, and you will recognize how quickly an entire nation may degenerate.

IN Germany the higher types have at present only one or two children. Families of healthy heredity very rarely have a number of children. Moreover, the higher type, in view of their good school and professional training, do not decide to marry much before their middle thirties, while the inferior type, feeling no responsibility whatsoever, give birth to children ordinarily between the ages 18 and 25, or even earlier, and these offspring are destined to become public charges. In other words, within a single century two hereditarily healthy children of a high type family will in the best case have only 16 descendants while, on the other hand, the five inferior type children of a family of weak heredity will bring forth during the same period 3125 descendants even at the statistically lowest rate of increase characteristic of the asocial group. However, since these children have a relatively high death rate, or do not beget more children, half of the number mentioned may well be subtracted from this sum. But this still leaves nearly 1600 descendants of the inferior type—that is, a hundred-fold increase over the

GERMANY

higher type. The bad outbreed the good.

That is the gigantic danger against which Adolf Hitler wants to protect Germany. A people will deteriorate when its best hereditary stock is losing out—that stock from which leadership should be replenished. During the rule of the now overthrown system in Germany a limitlessly liberal attitude toward this matter artificially promoted the increase of inferior types at the expense of the healthy. Through exaggerated welfare measures those deplorable pathological types were enabled to marry and to bring children into this world. To quote a particularly striking example, it even happened that criminals and mentally defective persons were given parole from penitentiaries and other institutions, in order to permit them to enter the matrimonial state and propagate. If, on the other hand, any welfare agency called for funds, in order to ward off sickness or a general run down condition in a healthy family, none of the state, municipal or other budgets contained provisions for such purposes. A fundamental change has occurred in that respect. The sterilization law in itself will have an educational effect, since it will make the entire nation more conscious of biological problems.

THE sterilization law is the result of much thought, and has been worked out and tested to its last detail. Each physician in the German nation must report to the health officer any case of hereditary disease which comes to his attention. The diseased will be given medical advice which is required by law in each case. If he is capable of taking an intelligent view of his own situation he may himself make application for sterilization. Otherwise his guardian or the competent health officer is obliged to do so. The application will be submitted to a Hereditary Health Court composed of two legal officers and two medical specialists in eugenic problems. The physicians of this particular court examine the hereditary diseased, and conduct inquiries into the respective conditions of his entire family. This procedure will ascertain whether or not the pathological case under discussion is likely to be a hereditary one. Eight clinically defined diseases are designated by the German sterilization law.

In addition, severe cases of alcoholism, in which the persons afflicted are otherwise mentally unfit, are subject to the provisions of the law. If, after the conclusion of the examination and inquiries by the physicians of the Hereditary Health Court, a case is clearly established, the operation will be ordered and performed by well trained surgeons or gynecologists in a hospital specifically appointed by the Court. It is also provided by the law that the physician who performs the operation may not be chosen from among those who had participated in the preliminaries of the case.

Should the person to be sterilized object to the decision of the Hereditary Health Court, appeal can be made to


Just before machine guns b

Court Reports Sterilization of 325 in Berlin

Eugen s Examination for Def tives Made on 348; 23 Escape Operation

By The Associated Press

BERLIN, June 19—Three hundred and twenty-five Berlin residents have been sterilized for the benefit of coming generations,' the Nazi eugenics court revealed today in its first report

Of these 143 voluntarily submitted to the vasectomy operation which makes it impossible for them to become parents but does not otherwise interfere with their sexual life

In all, 348 persons were examined by the court and in twenty-three cases no order was issued The report did not divide the persons operated on as to sex, but stated that the majority were men

The eugenics court deals with sterilization cases involving the prevention of children in families of persons regarded as defectives The criminal court penalty of sterilization against habitual sex offenders involves castration, as distinguished from the method used by the eugenics court

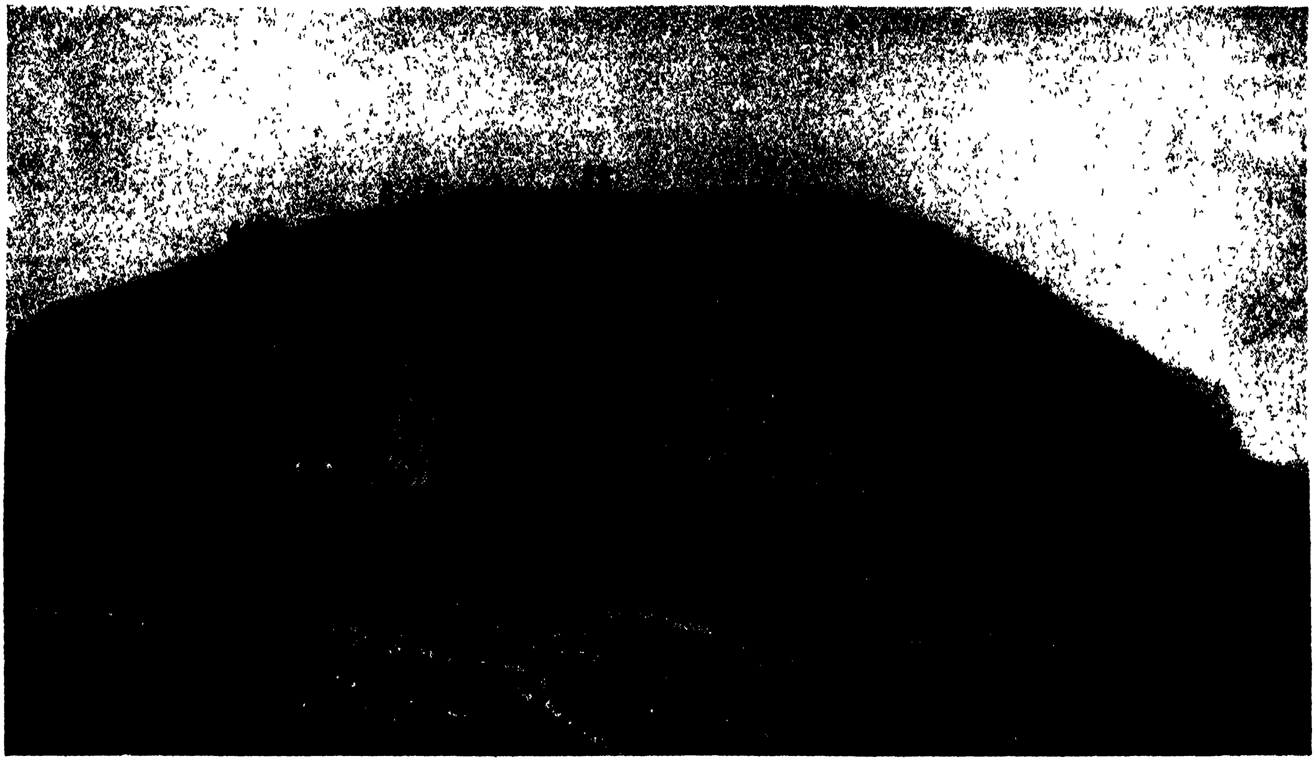
the Supreme Hereditary Health Courts. The latter are located in larger cities where, as a rule, special medical authorities can be called into the case. If such courts sustain the decision the sterilization can be enforced, unless the case is to be appealed. The possibility of compulsory sterilization guarantees that the law will be carried out in the most important and unusual cases

There are also, however, clauses in the law which are of a mitigating character. Where, in insanity cases, the persons afflicted are deemed to be inmates of asylums for life, they will not be sterilized Persons who voluntarily enter an asylum (which assumes the responsibility to see that no reproduction will be possible in any way) are exempt from sterilization, even in the face of Hereditary Health Court decisions.

Since conscientious objections of a religious nature figure so prominently in the propaganda against Germany and its sterilization law, they need to be mentioned at this point. It is, by the way, a historical fact that up to the middle of the 19th Century the choir boys of the Sistine Chapel were submitted to castration, in order to preserve the quality of the high treble voices of the boys. Apparently no conscientious scruples were raised against such operations, although they were obviously of a much more severe character than sterilization! On the other hand, nowhere in the entire creation of Divine origin, where the laws of God determine natural life—neither in the vegetable nor animal kingdom nor even among primitive peoples—is it possible for the defective and lower types to increase profusely. It was only because of a hyper-civilization that hereditary inferior types (which rather remind us of animal-like behavior than of the image of God) could, without any responsibility, propagate their kind without limit. If, on the other hand, men of the 20th Century have successfully used their God-given mind for the discovery of means which will guarantee the health and happiness of future generations, would it not rather be their further duty to prevent the coming into existence of unhappy human beings who would only become the source of trouble and sorrow for the rest? National socialist Germany considers interference with unfit life to be a sound application of the true Christian love of one's fellow man

STERILIZATION simply involves the separation of the spermatic ducts or of the tubes, by means of a minor operation. Persons subjected to it will suffer no effects on their physical or mental capacities, nor will they be restricted in the enjoyment of any pleasures life may offer. Furthermore, the sterilization procedure is to be made in individual cases a matter of the greatest secrecy.

It is only natural that the *negative* character of the sterilization law, the struggle against hereditary diseased offspring, will be supplemented to the fullest extent in national socialist Germany by *positive* measures. Hereditarily healthy families, especially those with many children, are to be given ample recognition and privileges. The sterilization law in force since January 1, 1934 will protect future generations in Germany from the pressing financial support thus far required by hundreds of thousands of hereditary defectives. The danger of their overwhelming growth, and the resultant interference with the lives of the hereditarily healthy, is banned forever.



The great Ziggurat at Ur, a staged tower erected about the 23rd Century B. C. by Ur-Nammu. It is exactly like the Tower of Babel, which was built by the same king, and was the main religious building of the city. It is in fair condition today

EXCAVATIONS AT UR*

By C. LEONARD WOOLLEY, M.A., Litt.D.

Director of the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia

(Concluded from August)

IN the course of our work we have learned quite a lot about the people of Ur. We were able to discover something of their handicrafts and even of their ideas, because, dug down into the flood silt, there were the graves of the people who had survived the flood, not necessarily people who had seen it, but a generation or two after it, and under the flood deposit there were plentiful remains of the antediluvian inhabitants. In the graves we found skeletons laid out rigidly straight, that being an entirely different burial custom from what obtained later: the Sumerians of our royal cemetery laid their dead on the side, with the legs bent and the hands brought up before the face in the attitude of one asleep. At the feet were put clay vessels for food or drink, thus showing presumably some belief in the journey of the soul to a future life. Those vessels, made without the wheel, are extraordinarily well made, with thin walls, well balanced, well shaped, and sometimes decorated with painted patterns, which, though simple in their geometrical elements, are extraordinarily well composed, beautifully adapted to the shape of the vessel, and they really make of these antediluvian pots the finest products of the potter's art that you get in the whole of Mesopotamia throughout all its long historic age. With them there came, both in the graves and in the pre-flood dwellings, queer figures of baked clay, with very slender modern bodies and grotesque heads, with reptilian faces and elongated dome-like skulls, like some modern sculpture! These are not portraits of women but figures of goddesses or demons worshipped by the people, whose religion must have been largely a religion of fear.

AT first sight there is nothing that is common to the great cemetery. You first of all get the apparent breach between the cemetery and what we call the Jemdet Nasr period, with its polychrome vessels. Then there is another break in culture and we come to what we call the al'Ubaid period, with something apparently radically different. But is it a difference? That is the question we have to answer. There are certain things which make one modify one's view as to these changes. We must have changes where we are dealing not only with centuries but with thousands of years. But if we can get links running all through, they are far more precious than all the diversities necessary in human progress; they prove much more than the variations do and they may even provide the answer to the particular problem we have set out to solve.

First of all, there is the great Ziggurat of Ur, the staged tower erected about the 23rd Century B.C. by Ur-Nammu. It is exactly like the Tower of Babel, which was built by the same king. This huge mass was the main religious building of the city. It dates to only 2300 B.C. and is extraordinarily well preserved. Was it first built in 2300 B.C.? Is there any link which can carry this back? Because the Ziggurat, or staged tower, which is a common feature of every great Sumerian city, is certainly a mark of the distinctive culture of the people.

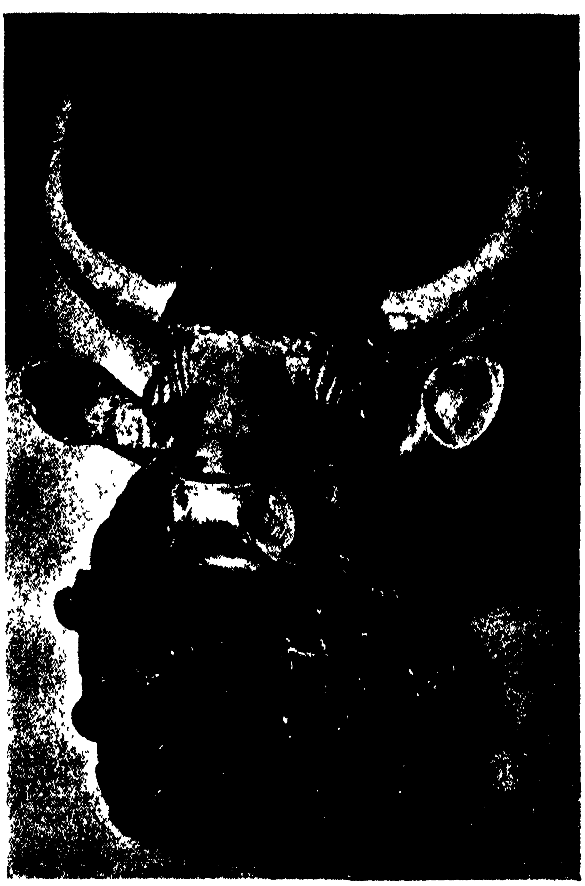
*Courtesy the *Journal of the Royal Society of Arts*. Photographs by the Joint Expedition.

If we can trace it back beyond the cemetery period, we shall have done something to prove our point of historical continuity. This tower stood on a platform, and on the platform there stood round the Ziggurat a whole range of religious buildings, mostly now destroyed, whose ground plan we have been able in part to recover. We dug through those ruined buildings on the Ziggurat platform and at a lower level we discovered an earlier range of buildings well enough preserved for their ground plan to be made out in every detail with absolute accuracy, so that here we have the ground plan of the Ziggurat platform as it was, not in 2300 B.C. but in 3100 B.C., that is, just after the close of our great cemetery period, and the buildings reproduce almost exactly the buildings of many centuries later. They were imitated by successive builders, so that continuity from 3100 B.C. was faithfully maintained for at least 1000 and probably for 2000 years.

Does it go any further? The terrace on which the Ziggurat stands is surrounded by a very heavy wall of mud brick about 35 feet thick and faced on the outside with limestone. It rests upon a much older and a wider wall, which follows exactly the same lines and contains within its area buildings which reproduce exactly the later buildings. This building must, from the character of its brickwork, go back to something like 3700 B.C., that is, it is older than the whole of our royal cemetery, and yet the link which binds it to 3100 B.C. is absolutely perfect. Every wall of this old building is reproduced in the later, and therefore the tradition does go back. But it goes back further than that. Inside the platform of the Ziggurat of 3700 B.C. we dug down, and we found first one wall and behind that another, walls built again of bricks of an entirely different type, which we know, by comparison with excavations carried out on other sites, such as Warka, the ancient Erech, go back to something like the fifth millennium B.C. Yet the tradition is exact, and there was already then standing and dominating Ur such a Ziggurat—on a smaller scale, certainly, but similar in nature—as we found was built in the 23rd Century B.C., and such a Ziggurat as was last restored by King Nabonidus of Babylon in the 6th Century B.C. The continuity is perfect from the 6th Century B.C. back to the fifth millennium B.C.

I have mentioned civilization. Of course, the treasures of gold and silver and mosaic, and so on, do indicate a civilization of a high order, but, when we use the term "civilization," what exactly do we mean? What connotes civilization as distinct from advanced but barbarous culture? I should say that civilization connotes a certain proficiency in art and technical science, such social organization as almost necessarily implies city life, where at any rate the State maintains its supremacy over the individual by a recognized system of law, while still allowing the individual free play for his character and for his predilections, and in the third place, I should desiderate for civilization a knowledge of the art of writing, for only when you have writing can you be certain of the preservation of thought, can you be sure that inventions once made will not be lost, that traditions inherited will not disappear with a subsequent generation, but that there is that regular and ordered progress without which civilization is static and really ceases to exist.

In Mesopotamia we have the art of writing. I suppose that to most people the cuneiform script, in its appearance, is familiar enough—those queer signs composed of wedge-shaped lines formed by the pressure of a chisel upon the surface of the wet clay. There you have finished writing, as it has been familiar to us for a long time. Fully developed, its character is obvious, but, if you take an earlier example, you find that the wedge-shaped line is absent. We have from the royal cemetery, for example, a golden bowl with an inscription on the side of it, but it has not got the wedge-shaped line. It is not cuneiform, properly speaking; it is linear writing, which is the precursor of cuneiform. It is only the shape of the composing line that is different—the signs are the same—so there the tradition is exact. Then, underneath the cemetery, where we found clay jar sealings, we also found tablets covered with writing, but these again are purely linear and not cuneiform, and I think that, with a certain amount of imagination, one can feel that behind the signs there are pictures. They are a little more naturalistic than the cuneiform signs. That is particularly noticeable in some tablets found by the Oxford Expedition at Jemdet Nasr, where the signs are clearly drawn, and we get a step further back in writing. The man was not doing exact pictures, but he had something in his head which he drew with a point instead of by pressing his chisel edge into the clay, and so we approach nearer to picture making.



Above: **Calf's head of gold and lapis lazuli decorating the front of the harp of Queen Shub-ab. The inlay is original, the wood is restored. *Below:* A bull's head of gold, with beard, eyes, hair, and horn tips of lapis lazuli. From king's tomb**

On a contemporary seal impression that we found at Ur there is an inscription and this has a definitely pictorial element in it: instead of the signs being built up of straight lines there are

curves, and we get closer to something naturalistic. At Erech or Warka there have come to light clay tablets on which the writing is reduced to a minimum and there are simply pictures, not signs at all, the actual objects being drawn with a sharp point in the wet clay. We cannot date these, but they again go back beyond the period of Jemdet Nasr and are almost certainly about contemporary with the last years of the al'Ubaid art, with its painted pottery. Here we get the art of writing carried back to its beginning. In Mesopotamia we can trace it from the finished script to the faint gropings after a script that we get in the pictograph. That again, I think, is a proof of continuity that cannot be overlooked.

The inlay stela from Ur. Scenes from war, made up of pieces of shell cut and engraved and mounted on a background of lapis lazuli. Found 1927-1928 season

AGAIN, we find the continuity in objects. Digging below our royal cemetery we found older remains, rubbish mounds, which contain objects thrown out from the temples, and among those objects are quantities of jar sealings. People took a clay jar which contained wine or something else and tied a piece of cloth over the mouth, and over that cloth they spread wet clay and on the wet clay they stamped their seal in order that the jar might not be tampered with. That clay jar sealing is exactly like the sealing wax over the cork of a modern wine bottle, and the seal was impressed in exactly the same fashion. Underneath our royal cemetery, and therefore belonging to an earlier date, we found such jar sealings. On one of them, rather crudely done, there is a representation of a chariot, with two men in it, drawn by donkeys. The subject is curiously familiar to us, because, though the jar sealing must date from about 3750 B.C., it is simply a forerunner of the great "Standard" of Ur, on which, in mosaic of shell and lapis lazuli, there are the same chariots drawn by donkeys and with fighting men and the driver in them. Here is a link which binds the great cemetery with its immediate past.

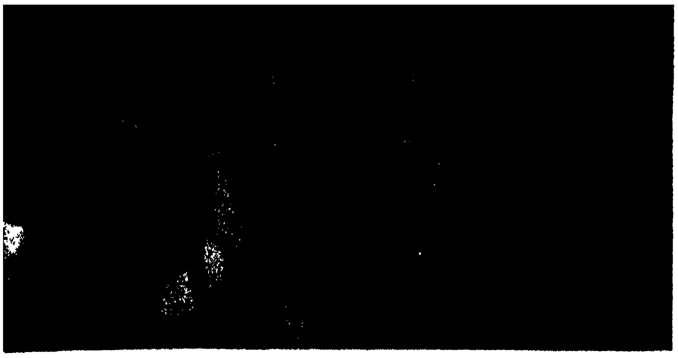
Then we can take another thing, the cylinder seals which people carried and with which they signed the written documents of their time. They are so common that they are a most precious record.

I think that in what I have told there is enough to prove to most people that the remarkable civilization illustrated by the royal tombs did not spring out of the blue. Of course, it could not do that; but it was not introduced from abroad into a barbarous country. It was the result of a long and slow process of evolution, and that civilization was built up by degrees in the country in which we find it. Its roots are there as well as the flower. By excavation in Mesopotamia we are able not merely to discover a remarkable and hitherto unsuspected phase in the life of one country, but we can trace it almost to its origin, and in that we are doing no unimportant thing. I have suggested that this art of the great cemetery has profoundly influenced later ages. I have shown how the forms of architecture continued have been inherited by ourselves. One could expatiate on that side of the subject for a very long time indeed. We find in Egypt, before the First Dynasty, numerous imports from Mesopotamia, which seem to imply that the Sumerians supplied to the barbarous people of Egypt, as they were then, just that impetus which enabled them to start out for themselves and to develop the remarkable and independent civilization which is familiar to us as the civilization of the Nile Valley. We do know for a fact that the Sumerians imposed their culture upon surrounding peoples and so impressed it upon their successors, the Babylonians, that, civilized as the Babylonians were, they made no new discoveries at all; they hardly advanced beyond what their predecessors had known and they preserved civilization rather than invented it. We know, too, that the Sumerians sent out the ancestors of the Hebrews with all the traditions of law, civilization, religion and art which they had themselves evolved in their home country and which the Hebrews never entirely forgot, but by which they were profoundly influenced.

The Sumerians were an extraordinarily important people, and the more we look at them the more we see that they were essentially modern. Modern man goes back as far as we can say we are able to understand the feelings of the man of the time. If we can look at the early Sumerians and read their writing, study their works of art and understand their buildings and more or less grasp their civilization, if we can know from what they have done that in our circumstances they would do as we are doing and that, similarly, we in their circumstances should have done as they did, then we are fully at home with them.

THEY are modern man, distinct altogether from those paleolithic and neolithic peoples with whom we do feel terribly at sea. Modern man probably goes back to something like 6000 B.C. We have him extraordinarily well exemplified in the Sumerians, and, because their influence never died out and they have played a great part in the history of human progress, when we watch their earliest beginnings, and trace them up from those beginnings to a flower of art, we are watching, so far as we know at present, the earliest efforts made by man to rise above himself and to develop that extremely complicated and complex form of life that we call civilization, and we are observing the process not merely in a forgotten and unimportant corner of the earth but in the main stream of human life. The more we learn about it, the better we can understand the progress which man as a whole has made, and I think, therefore, the better we can understand history in general, both in the past and in the present.

Plumbers in Ur did lasting work. This is an early pipe drain leading to a cesspool beneath one of the re-excavated buildings of the city



As the obsolete jetty looked after dynamite had cut pilings off below the surface and before being dragged from the sand by a horse team

As a water jet displaced the sand the dynamite charge on a submerged to the required depth against the pile that is to be

BEACH BLASTING*

By STEPHEN J. RYAN

SEVERAL years ago the Borough Council of Beach Haven, New Jersey, constructed four jetties of oak and chestnut piling along the beach to protect it from erosion. The piles were driven 25 feet deep into the sand in long double rows. These clusters of pilings on the beach were apparently satisfactory but after Beach Haven had begun to develop rapidly as a summer resort, the authorities decided to erect stone jetties extending out into the ocean for a distance of 100 to 125 feet. The wooden jetties were no longer necessary and, as it was desired to increase the size of the bathing beach and to extend the board-walk, the Council decided to remove the unsightly wooden projections. Workmen endeavored to pull each pile out of the sand by the use of a large tripod and block and tackle, aided by a water jet. This process was found to be too costly as the largest number pulled out in a day by several men was 25, and the average much less than that.

The Borough Council then decided to try dynamite and an explosives expert of the duPont Company was requested to look over the job. Advice was desired as to whether or not it would be practical to cut off the pilings at a safe distance below the surface of the sand by the use of dynamite.

The explosives expert asked the Mayor and Council to purchase a small quantity of dynamite and some electric blasting caps for a "test day." The result of the "test day's" work was the removal of 133 oak pilings, each ranging from eight to ten inches in diameter. Eighty-two sticks of quarry gelatin dynamite and about 50 electric blasting caps with eight-foot lead wires were used for that performance.

IT was then decided to use 60 percent straight nitroglycerin dynamite and to try the propagated-detonation method in which the shock of one explosion sets off other charges in the same line. This worked with complete success and due to the fact that an electric blasting cap for every charge was rendered unnecessary the cost was further reduced.

It is, of course, impossible to push or drill a hole through loose sand to place a charge of dynamite, for the hole closes as fast as made. Therefore, several lengths of fire hose were run from adjacent fire hydrants to the point of operation and connected with a water jet device consisting of a piece of one-inch pipe ten feet long.

In loading and shooting, two sticks of the dynamite were bound to the end of ordinary wooden laths with twine. In placing these charges the jet of water was pointed into the sand beside the pile. As the water displaced the sand the dynamite tied to the end of the lath followed the jet down to whatever depth was desired. Each lath was marked at a point six feet from the dynamite so that a uniform depth of charge was assured.

Eleven such charges were planted against a like number of pilings for each shot. The primed charge, consisting of three sticks of dynamite, one of which was primed with an electric blasting cap, was placed against the center pile and the two-stick charges, without caps, were placed against each of the five pilings extending on each side. After each shot, a crater was left in the sand and it was easy to determine whether each pile was cut off cleanly. Occasionally a small extra shot was needed.

By using this method and placing eleven charges each time, it was possible to load, connect, and shoot 1500 piles in 6½ days or a daily average of 230 pilings. The total cost of cutting off the 1500 piles was 26½ cents each. This includes the cost of approximately 1200 pounds of dynamite, 550 blasting caps with lead wires, and 6½ days' time for a blaster.

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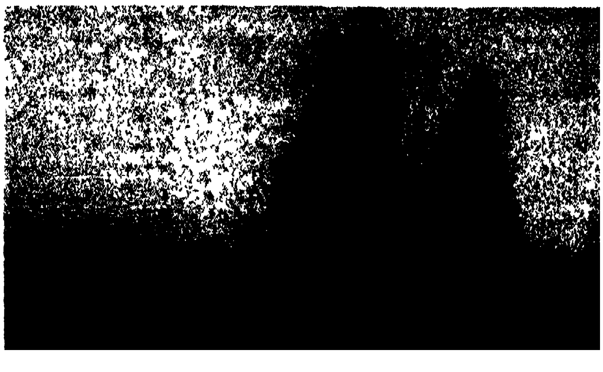
*Courtesy *The duPont Magazine*

A row of charges in place against piles, indicated by the projecting laths, and ready to be fired. Note ice which shows working conditions

One charge at the middle of the line was primed with a detonation set off the five charges on each side—eleven with



STARS ON PARALLEL TRACKS

By HENRY NORRIS RUSSELL, Ph. D.

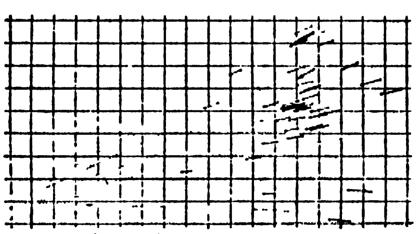
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

FROM immemorial times, watchers of the sky have recognized the presence of clusters of stars here and there in the heavens. The most conspicuous of these, the Pleiades, is one of the most widely known objects in the heavens and received its name in classical times. Two or three other clusters also bear Greek or Latin names: the Hyades, a widely scattered group in Taurus; the small, compact Praesepe in Cancer, which looks to the eye like a hazy patch and is resolved into its separate stars only by a field-glass; and another scattered group farther east in the sky, known as Coma Berenices and commemorated in a poem of Catullus. Other clusters, too closely packed to be resolved into separate stars by the unaided eye, are found between Perseus and Cassiopeia and between Scorpio and Sagittarius. With the telescope, of course, dozens and hundreds of fainter clusters have been recognized.

Star groups of this type are generally called "galactic" clusters, to distinguish them from the fainter and more remote globular clusters. As their name indicates, they show a very marked preference for the region of the Milky Way, and are rare in other portions of the sky, though Coma Berenices is almost at the north galactic pole. The large apparent size of this cluster, and the brightness of the stars composing it, many of which are visible to the naked eye, suggest that it is much nearer than the average—a conclusion confirmed by fuller investigation. Though its direction from us is nearly at right angles to the Milky Way, it is therefore not very far from the central plane of our system.

THERE can be no doubt, from mere inspection, that a close cluster like the Pleiades is a real physical aggregation of stars. The probability that six stars, conspicuous to the naked eye, should lie in so small a region of the heavens on a mere chance distribution, can be calculated and is excessively small. For more scattered groups this argument is less conclusive, and considerations of probability show that some "field" stars in front of the cluster or behind it are projected in the heavens upon the real cluster. To distinguish these, we must have recourse to the motions of the individual stars, which have been accurately determined in a number of cases.

All the bright stars of the Pleiades, for example, are moving together in the sky at very nearly the same rate and, moreover, have nearly the same radial velocity—facts which put their real physical connection beyond all possible doubt. In the Hyades the majority of the stars show a similar common proper motion and are receding from the sun at about the same rate. But here and there one is found with quite a different motion, which is evidently an accidental intruder. The bright star Aldebaran is the most notable of these. This decisive test shows that Praesepe and Coma Berenices, like the groups already named, are real physical clusters, though in the latter case there are a good many superposed field stars.



Courtesy Astronomical Society of the Pacific

Motions of the Hyades Cluster. The arrows represent motion in 50,000 years, also the direction of motion. Though the motions appear to be convergent, they are actually parallel, the convergence being only a perspective effect. These stars are all traveling along in one cluster

It has been told long ago in these columns how Professor Boss, from his accurate catalogue of proper motions, showed that the apparent motions of the stars of the Hyades converged toward one point in the sky. This is an obvious effect of perspective, for a cluster which is receding. Spectroscopic observations confirmed the recession and made it possible to determine the actual distance of the cluster, which is 40 parsecs or 130 light-years. The Pleiades are almost four times as far away, and Praesepe about the same distance. For the double cluster in Perseus, the estimated distance is 5000 light-years, and many galactic clusters must be remoter.

The searching test by proper motion has revealed several clusters too wide to be conspicuous to the eye. A notable one is found in Ursa Major. Of the seven stars of the "Dipper" (which, by the way, is the only American constellation, the name being practically unknown on the other side of the Atlantic), five are moving together, and evidently form a widely scattered cluster. Hertzsprung's careful study shows that various apparently disconnected stars, notably Sirius, share this motion and really belong to the group. An enormous aggregation of more distant and very brilliant stars in Scorpio and Centaurus, and the Southern Cross, was first recognized by Kapteyn. Its brightest members are 200 or 300 light-years from the sun, and the extent of the cluster, or stream, must be fully as great.

THE common motion of the stars of any one of these groups is the strongest indication of a common origin. The mere fact that they keep together in space is as good a reason for supposing them to be really related in some way as is the similar motion of a flock of birds in the sky. Moreover, as we shall see, there are many forces which tend to cause the motions of the cluster stars gradually to differ from one another, and so ultimately to disintegrate it, while there are no known influences which would cause stars originally unrelated, or with random motions, to congregate into a group moving together. Moving clusters, then, may give us some insight into the remoter past of our galactic system. At interstellar distances the only force which needs to be considered is gravitation. The influence of this on the motions of clusters has been discussed by Eddington, Jeans and, very recently, by Professor Bok of Harvard, to whose results the present summary is much indebted.

Suppose, first, that there was a cluster of stars, entirely isolated in space, which would not even attract one another. Each star would then move on a straight line with uniform speed, indefinitely. If the original motions were strictly parallel and equal, the cluster would remain together forever. But, if the motions differed ever so little, the stars would gradually draw apart and the group would spread out.

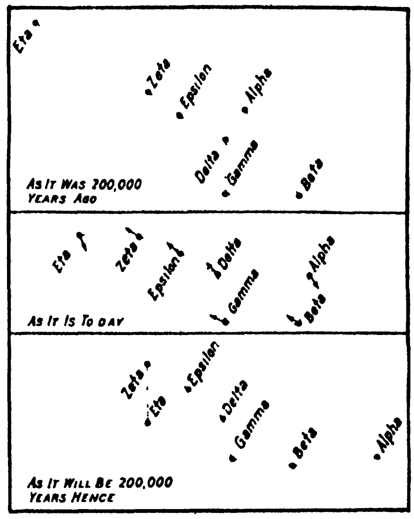
Of course, the stars actually attract one another. If their motions in space were originally exactly the same, so that they had no motion relative to one another, their mutual attraction would

cause them gradually to fall in toward the center of the group, and the cluster would collapse at a slow but ever-increasing rate. This catastrophe could be avoided by setting the stars into slow motion; each one would then describe an orbit around the center of the whole mass, influenced somewhat by the attraction of its immediate neighbors. With a proper adjustment of velocities, the cluster might maintain itself for an extremely long time. Individual stars would move in sweeping curves, usually not of very simple form, and would successively visit many parts of the region occupied by the cluster. But, as some stars left a given portion of this region, others would come in to take their places, and the general appearance of the group might remain practically unaltered.

THE stars which form the known clusters are so widely scattered that these orbital motions would be very slow. The Pleiades, for example, form a group about three parsecs, or ten light-years, in radius. Professor Bok estimates the total mass as 250 times that of the sun. A simple calculation shows that a star revolving in a circle at the outer limit of the group would have a period of some 30 millions of years. Those nearer the center would move somewhat more rapidly; but, even so, their orbital motions would be so small during the century or less covered by accurate observations of their position, that little or no perceptible change would be detectable. This is a comparatively dense cluster. For the Hyades, the calculated rotation period is 80 million years, and for the Perseus cluster about 140 millions. Though no sensible change in such bodies can be expected within the interval of accurate human observations, the longest of these periods is but a small fraction of the known age of the Earth.

It is altogether probable that these vast clusters are at least as old as our planet, and we may therefore believe that during their past history their individual stars have circulated about the center many times, and their detailed configuration has been completely changed again and again. Had there been present originally stars whose motions were much more rapid than the others, they would have escaped from the gravitational attraction of the general mass in a relatively short time (from 20 to 50 millions of years), so that only those which were originally orderly and slow-moving remain for our recognition.

Even if utterly isolated in space, such a cluster could not exist forever. Now and again, though at rare intervals, two of its stars would pass very close to one another (say no farther than the earth's distance from the sun), and their velocities would be greatly altered by mutual attraction. During some of these encounters one star would be slowed, and the other speeded up so much as to enable it to escape from the cluster. This process, though slow, is substantially irreversible, since the ejected stars wander off into remote portions of space, and the chance of an incoming star passing close to a cluster member in such a way that its motion is slowed and it is captured is excessively small. This disintegrative process, although real, is however so very slow-acting that it is of little importance in comparison with two others.



The Dipper consists of five stars moving together and two stars, Eta and Alpha, which merely happen to be in line with this cluster at the present period. From Leaflet 28, Astronomical Soc. of Pacific

The first disturbing force arises from the general attraction of the great mass of stars composing the Milky Way. If this attraction were exactly the same in amount and direction at all points within the cluster, it would have no disintegrating effect. All stars in the cluster would move in similar curves, describing some vast orbit about the greater mass; but there would be no tendency to drag the stars apart, and none to pull them together, save their own mutual attraction. But the actual attraction of the Milky Way, especially if its mass is considerably concentrated in a central region, is not of equal strength at all points, nor does it act in parallel lines, but in directions converging toward this center. The differences, whether in amount or direction, between these galactic attractions, constitute forces tending in some regions to draw stars in toward the center of the cluster and in others to pull them away.

These "tidal" forces, though very small, are unremitting in their action, and they will pull any cluster to pieces if given time enough, unless the attraction of the general mass of the cluster itself upon the component stars is sufficiently great to counteract them. This demands that the cluster shall have a tolerably high density. Bok calculates that a mass equal to the sun's, for every ten cubic parsecs of space, is required. This would put stars like the sun about seven or eight light-years apart, which is hardly closer together than the randomly moving stars are in our neighborhood. The star density in the Pleiades is at present about 20 times this; that of the Hyades is much smaller and between two and three times the critical value.

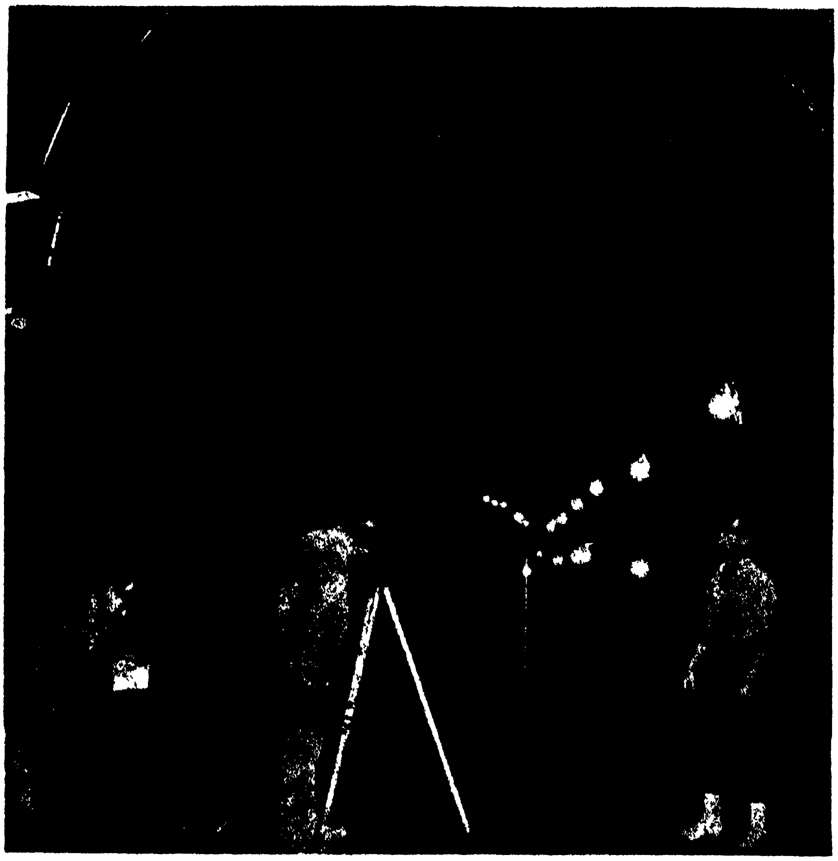
WERE these tidal forces alone at work, a dense cluster like the Pleiades would be kept together indefinitely by its own attraction. But there is another disintegrative force. As the cluster moves through the general field of stars, those which it approaches will pass right through it. The chance of a collision of a cluster star with an outsider, or even of a very close approach, within planetary distances, is extremely small. But, nevertheless, each interloper, as it passes through the cluster, will disturb by its attraction the motions of the cluster stars. It is easy to see that the effect of this attraction will be to pull each star toward the nearest point of the track of the stranger (the forward and backward components balancing out). For a cluster moving through a field of stars at rest, these attractions would evidently tend gradually but steadily to increase the motions of the cluster stars in directions at right angles to its own motion, without modifying perceptibly the velocities in the direction of the general motion. These more rapid motions would in time carry the cluster stars farther from the center, before they were drawn back by the general attraction, and the cluster would gradually spread out in a direction at right angles to its own motion.

In the actual case, the intruding stars are moving in all directions, and the cluster is moving too, so that the effects are more complicated, but not greatly different in kind. Professor Bok's calculations show that a cluster such as the Hyades would expand by less than 10 percent in the next billion years. After two billions of years its greatest diameter would be 25 percent larger than now; but by this time its density would have shrunk near the critical value, and the tidal forces of galactic attraction would begin to get in their work. A little more than two and a half billion years hence, the spreading will become much more rapid, and within three billions of years the cluster will become practically disintegrated into widely separated stars. The Pleiades, with its greater present density, should last ten times as long; but, even so,

(*Please turn to page* 165)

BUILDING THE WORLD'S

By ROBERT D. SPEERS
Metropolitan Water District of Southern California



Surveyors in the Valverde tunnel checking the accuracy of the bore

BREAKING record after record, a seasoned army of hard-rock miners is pressing forward, out on the California desert, on the largest tunnel driving program ever undertaken in the history of engineering. They are excavating 29 eighteen-foot bores, totaling 91 miles in length, through the rocky hearts of the bleak mountain ranges which lie as barriers between the Colorado River and the Coastal Plain of southern California.

Through these tunnels eventually will be turned a billion gallons of water daily from the Colorado River to serve the 13 municipalities which comprise the Metropolitan Water District of Southern California.

This 91 miles of tunnel constitutes the most important link in the 220,000,000-dollar Colorado River Aqueduct system, the total length of which will be 241 miles from the Colorado River to the main terminal reservoir. In addition, 144 miles of huge distributing mains are to be built to carry the aqueduct water from the terminus of the main line to the cities to be served.

At the head of this undertaking is F. E. Weymouth, who occupies the position of general manager and chief engineer of the District. One of America's distinguished engineers, Mr. Weymouth was for many years chief engineer of the United States Reclamation Bureau and was the builder of many of the outstanding reclamation projects in the West. With the late Arthur Powell Davis, he prepared the designs and estimates for Boulder Dam, sister project to the great aqueduct, construction of which he is now guiding.

UNDER Mr. Weymouth's direction, an army of 4400 men, working from more than 30 desert construction camps, is driving tunnel at the rate of three and one-half miles per month.

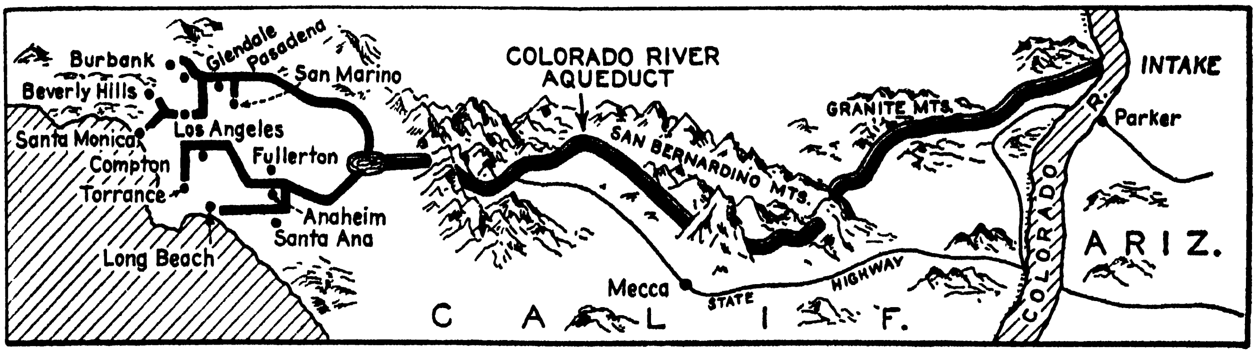
Thirty-three miles of this tunnel, located in the San Bernardino Mountains in the heart of California's desert region, is being excavated by forces employed directly by the Water District. The remaining 58 miles of bore is under contract to 13 large construction companies which are working under the direction of District engineers.

Longest of all the 29 aqueduct tunnels is the East Coachella bore, 18 miles from end to end, and being driven by Water District forces. Engineering studies reveal that from 15 to 20 years would be occupied in the excavation of the huge bore if the work were to be carried forward in the conventional manner; that is, from its two portals alone. Since the total construction period of the aqueduct project will be approximately six years, it is clear that some other method was necessary in order to shorten the length of time required for tunnel construction.

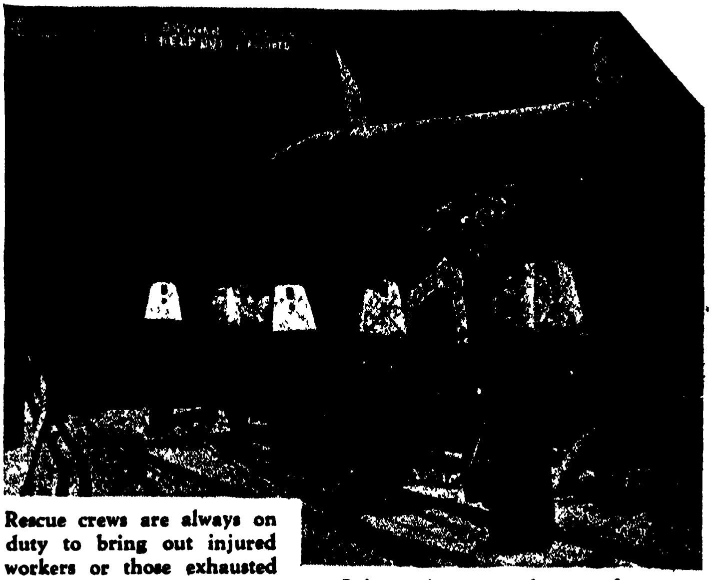
INSTEAD of attacking the tunnel from its two portals, District construction forces drove four horizontal adits, or access tunnels, into the mountainside to the line of the main bore. At the junctions of these adits and the main tunnel, crews commenced working on the bore in two directions—east and west. For each adit, then, two working faces were opened, making it possible for eight crews to attack the tunnel instead of two, as would have been the case had work been carried forward from the two portals. The access adits constitute in themselves sizable pieces of the tunnel construction, varying from 600 to 3000 feet in length.

A similar problem confronted engineers on the aqueduct's second longest bore—the 13-mile San Jacinto tunnel, which pierces a flank of one of southern California's loftiest peaks. Topography at this point was such, however, that it was impracticable to drive in horizontal adits as was done on the Coachella bore to give access to the tunnel line. Engineers therefore reached the tunnel from above, sinking a vertical shaft to a depth of 796 feet to the tunnel line. At another point they compromised between the horizontal and vertical methods of approach by sinking a shaft down to a depth of 246 feet, and then driving a horizontal cross-cut for a distance of 935 feet, linking the base of the shaft with the line of the main tunnel. In addition, San Jacinto tunnel is being attacked from its west portal,

LARGEST AQUEDUCT

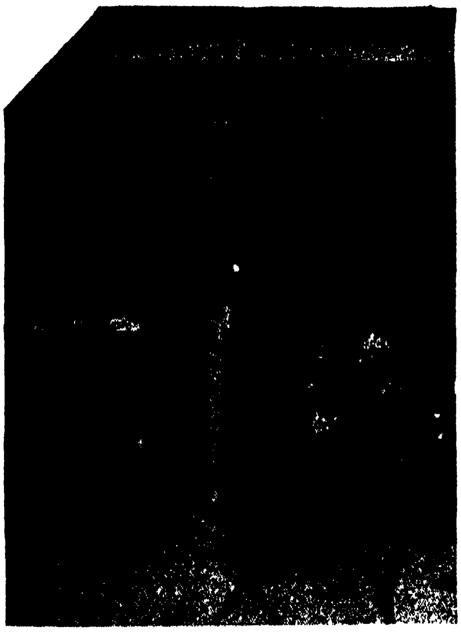


Map of the route of the Colorado River Aqueduct, showing terminal branches



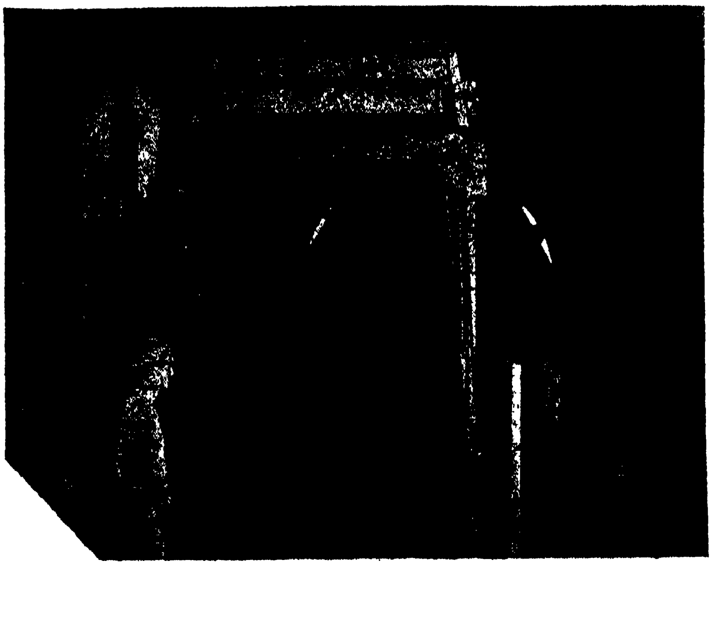
Rescue crews are always on duty to bring out injured workers or those exhausted by the intense summer heat

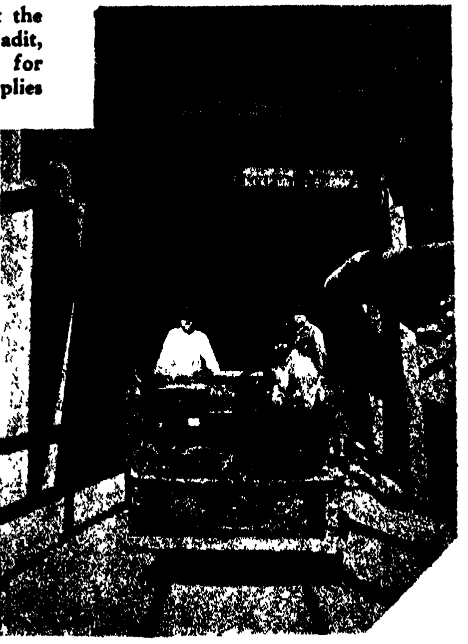
Below: A storage-battery locomotive. Note steel helmets on workers to prevent head injuries



Tunnels are so long and so large that switching facilities are provided, as shown, at the junctions of the adits and tunnels

Below, left: A scene at the lower end of a vertical adit, showing elevator used for conveying men and supplies





making a total of five headings being worked on the bore.

These methods of attack are being used, also, on several of the other longer aqueduct tunnels. Eight-mile Iron Mountain tunnel, for instance, is being driven from one portal and one shaft; West Eagle Mountain tunnel, five miles long, is being driven from one portal and one adit; Valverde tunnel, seven miles in length, is being attacked from four shafts; Copper Basin tunnel No. 2 and Whipple Mountain tunnel both are being driven from adits.

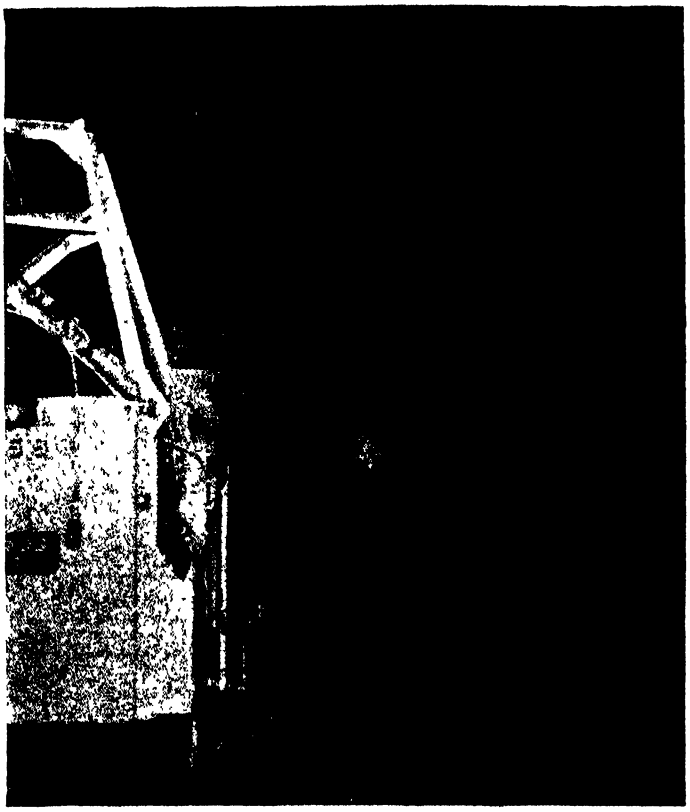
Many of the aqueduct's shorter bores, of course, are being excavated in the more conventional manner; that is, from the two portals, or from a single portal.

ONE of the notable features of the great undertaking, no matter which method is used, is the hair-splitting accuracy that is necessary in order to bring the various tunnel sections together with nicety. To accomplish this the Water District maintains a crew of engineers and surveyors whose task it is to check constantly upon the progress of the work and see that the construction forces are adhering to the tunnel line. Working with precision instruments, they can detect the slightest deviation in grade or angle.

Operating far underground, these surveying crews are confronted with many problems not encountered in similar work on the surface. One of these is the lack of adequate light for some of the finer observations. To overcome this difficulty, a powerful lamp has been developed which allows only a fine vertical sliver of light to escape. Transitmen are able to sight upon this slender beam from great distances down the tunnel. For other types of observations, pocket flashlights are suspended from the roof of the tunnel.

The fundamental routine of actual tunnel driving is much the same all along the far-flung construction front. It consists of three repeated steps—drilling, blasting, mucking—over and over again. Drill carriages, mounting as many as four or more pneumatic or automatic drills, are in general use along the aqueduct line. From 20 to 60 holes, from six to twelve feet deep, are drilled in the tunnel face, loaded with explosive, and fired. After the blast, the shattered rock is loaded onto waiting cars and hauled out to the dump. On tunnels where vertical shafts are used, the cars usually are hoisted, one by one, on cages.

Several types of mucking machines are in use along the aqueduct line. The one most generally in operation shovels up the muck in an electrically operated dipper, tosses the broken rock onto an endless belt which conveys it to an empty dump car attached to the rear end of the machine. Other types have swinging booms, designed to operate in the cramped space of a tunnel, which drops the muck directly into the cars.



At the working face of one of the tunnels. Steel liner plates are installed as work progresses, in order to avoid cave-ins

In many of the tunnels, cars are shifted by means of a pneumatic hoisting arrangement called a cherry-picker, which lifts the empty cars vertically off the tracks to permit loaded ones to pass under. In some cases ingenious devices have been perfected, combining the functions of a drill carriage and a car-shifter.

In most of the tunnels motive power for the dump trains is provided by huge storage-battery locomotives capable of pulling trains of from five to ten dump cars with a capacity of four to six cubic yards. In a few of the workings the locomotives are operated by means of trolleys.

Much of the aqueduct tunnel is through solid rock and stands unsupported. Both timber and steel support is used when soft or shattered sections are encountered. All of the tunnels will be lined with concrete before the aqueduct is put in operation.

With desert summer temperatures ranging as high as 130 degrees, special attention has been given by District engineers to proper ventilation of the tunnels. Exhaustive studies of the subject have revealed a number of interesting facts. It was found that, regardless of the temperature of the air being blown into the tunnel, it reaches the face at approximately the same temperature as that of the rock within the tunnel; that rock temperatures vary from 72 degrees to 101; that broken rock formations are considerably cooler than hard, dense rock.

Gigantic though it is, tunnel driving is by no means the only important phase of aqueduct construction. Siphon building, pumping, conduit construction, and power-line construction from Boulder Dam, are a few of the other sections of the project which will be, and even now are being, taken in stride by the aqueduct builders.

STRICTLY independent of each other, and yet wholly interdependent one upon the other, are the Colorado River Aqueduct and Boulder Dam projects. The aqueduct, being built by the Metropolitan Water District, depends upon Boulder Dam for proper regulation of the Colorado River and for cheap electric energy needed to pump the aqueduct water over the mountain ranges lying between the river and the Coastal Plain. Thirty-six percent, or 400,000 horsepower of the power generated at Boulder Dam will be used for this purpose.

On the other hand, Boulder Dam, being built by the Federal Government, depends upon the operation of the aqueduct for economic success. This is true because the Water District will be the Government's largest customer for both water and power. The revenues to be derived from the sale of these two commodities will in a large part amortize the cost of the dam project.

Few as yet realize that the aqueduct overshadows the dam in size. Cost of the dam proper is about 100,000,000 dollars, whereas the aqueduct bond issue, voted in 1931, was for 220,000,000 dollars. The rapid progress being made and economies which have been effected indicate that the project will be built at a cost under that figure; but even so, it will represent an investment twice as large as that required for the construction of the Federal dam.

Color Filters

Provide the Advanced Amateur Photographer With a Fertile Field for Experimenting

By WALTER CLARK, D.Sc.

WHEN a beam of sunlight is passed through a glass prism, it is split up into a band having the colors of the rainbow. These colors appear in the order shown in the accompanying diagram, and they form what is known as the spectrum.

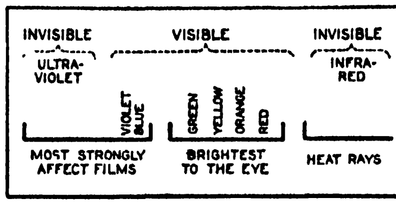
For general picture making, the infrared rays are of no account because ordinary or even panchromatic films are not affected by them. On the other hand, the ultra-violet has a very strong effect on all films. Although only a small proportion of the ultra-violet gets through a camera lens, even this small amount sometimes has to be taken into account. There is practically no ultra-violet in the light from an incandescent lamp, but there is a fair amount in sunlight.

ORDINARY film is affected by the parts of the spectrum ranging from the ultra-violet through to the middle of the green. Verichrome behaves similarly, although it is much more affected by green and yellow light. Super-sensitive panchromatic and panatomic films, on the other hand, respond to the ultra-violet and the whole of the visible spectrum right through to the red.

Because of the intensity of the ultra-violet, violet, and blue rays in sunlight, most of the recording of images on a film is produced by them. The sensitiveness to the other visible colors is, therefore, largely swamped by the effects produced by these rays.

If the chief effect on a film is produced by these rays, the tones in the photograph will not appear correct in the same sense that the eye saw the subject. We can, however, cut out the violet and ultra-violet, so that they do not reach the film, and then a more natural-appearing picture will result. This is done by placing a piece of colored glass or gelatin, a "filter," over the lens of the camera.

The filters most commonly used are pale yellow in color; this is the color which results if the ultra-violet and violet are removed from white light. All yellow glass and gelatin is not satisfactory, however, because some kinds that may appear to the eye to be the right color, actually let through some ultra-



The colors of the spectrum, as they are of interest to the photographer

Courtesy Eastman Kodak Company

Using a filter with panchromatic film brings out fine cloud effects

violet and the filter is largely ineffective.

Suppose we were photographing a landscape with clouds in the sky, and we used a film which responded only to ultra-violet, violet, and blue light. In our picture we should not be able to distinguish between the clouds and the sky if we gave enough exposure to give detail in the landscape. Clouds and blue sky are both rich in ultra-violet, violet, and blue, but there is a very marked difference between them. The light from clouds, being white, actually contains a lot of green and red light, while that from the blue sky does not. Therefore, we must use a film that will respond to green, or to green and red light, and put over our lens a filter that does not let through much ultra-violet, violet, and blue.

Since the filter cuts out some of the light that would otherwise affect the film, it increases the exposure that must be given. The amount by which the exposure must be increased is known as the "filter factor." It indicates the number of times by which the exposure must be increased when using a filter, as compared with the exposure necessary without the filter. The deeper the yellow color of the filter, the more violet and blue it removes, or "holds back," and consequently the higher is the filter factor. At the same time, the deeper yellow filters give more "correction"; that is, for example, they cause white clouds to show up more clearly against blue sky.

Filter factors are shown in the following table:

Filter	*N C Film*	*Verichrome*	*Panatomic*	*"SS" Pan*
K-1	3½	2½	1½	1½
K-1½	6	4	1½	1½
Kodak Color	6	4	—	—
K-2	8	4½	2	2

THE K-1 filter is pale yellow and is intended as a correcting filter when short exposure is of more importance than a high degree of correction. The K-1½ and Kodak Color filters are somewhat darker, and give better correction, although requiring somewhat longer exposures. The K-2 is a still darker yellow filter, giving the best correction possible with ordinary and Verichrome films, and practically full correction (recording tones as the eye sees them) with the panchromatic films. It is the best all-round filter for use outdoors with "SS" pan and panatomic films.

In landscape work the yellow filter performs another valuable function. It gives sharper detail in distant objects. On the majority of summer days, the distant hills and other objects in a landscape appear somewhat hazy. If they are photographed on ordinary or ortho films without a filter, they appear "flat" and without detail. This is because the haze scatters blue light and so tends to blur the detail of objects seen through it. While haze scatters blue light, it does not scatter green light so much, and red light still less. So, if a yellow filter is placed over the lens to cut down the diffused blue light, it is possible to photograph through the haze and the detail in the distant objects will be sharp.

With the "sky filter," one half of which is yellow, and the other half clear, the sky is photographed through the yellow part of the filter, while the landscape is photographed through the part that is not colored. The exposure for the landscape is thus not increased, and the filter shows up the clouds against the darker sky. This filter can not take the place of a general purpose filter.

SUNDIALS AND THEIR CONSTRUCTION—VI

Lines of Declination; Signs of the Zodiac

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory

ANCIENT diallists often placed upon their dials certain lines, called lines of declination, which recorded the entrance of the sun into the various signs of the zodiac. This gave them a measure of time, because it takes the sun about a month to pass from the beginning of one sign to the beginning of the next. Feast days, holy days, events of importance, and the time of year were also shown by these lines. If one wished to be facetious he could add lines commemorating birthdays, wedding anniversaries, and so on.

Today such lines are usually used for ornamentation rather than for the utilitarian purposes of not many centuries ago. Since the location of these lines on the dial plate depends upon the position of the sun, they have not entirely lost their usefulness even in this day and age. They have an educational value, for by them one may obtain a clearer conception of the motion of the earth in relation to its all-important luminary—the sun.

The sun, in its apparent movement among the stars, traces out a path called the ecliptic, the plane of which is inclined to the plane of the celestial equator at an angle of about $23\frac{1}{2}^\circ$. During one half of the year the sun appears north of the celestial equator, and during the other half south of it. The sun's distance north or south of the equator is called its declination, and is expressed in degrees and minutes of arc. The declination varies from day to day. The amount of this declination, for each day, at apparent noon, is given in the table, where the northern declination is preceded by a plus (+) sign and the southern declination by a minus (—) sign. Although data have been omitted, which may be easily obtained from any good almanac, this table is inserted because it is not always found in a convenient form for use in the construction of the lines of declination.

IT will be necessary for the reader to become familiar with other parts of the dial not previously mentioned, that are essential in the construction of the lines of declination or other furniture. The nomenclature and definitions of these essential parts are given below.

1—*The nodus.* This is a descriptive term introduced by the authors. In order to trace out the path of the sun on any particular day, the shadow of the whole style cannot be used. We must therefore select some point on the style for this purpose, which will be called the *nodus*. The nodus may be at the apex of the style; or at any other point along the style that is convenient, in which case it could be designated by a small, thin bar laid crosswise on the style, or by a notch cut in the style, so that the shadow cast by the nodus may readily be discerned on the dial plate, in sharp contrast to the shadow of the whole style.

2—*The perpendicular style.* A line drawn through the nodus, intersecting the dial plate at an angle of 90°.

3—*Foot of the perpendicular style.* The point where the perpendicular style intersects the dial plate.

4—*Height of the perpendicular style.* The distance measured from the nodus to the foot of the perpendicular style.

5—*The horizontal line.* This line is seldom placed on dials, although it plays an important part in making a dial useful. It is a line drawn on the dial plate at the intersection of a plane passing through the nodus, parallel to the plane of the horizon. The lines of declination need not extend beyond the horizontal line. The approximate time of sunrise and sunset may be deduced from the points among the hour lines where the lines of declination intersect the horizontal line.

RATHER than clutter the reader's mind with many diagrams and lines, only those necessary for a proper understanding of the method of construction will be used. Although the fundamental principle of plotting a line of declination on a dial plate is the same for all dials, each type of dial will be treated separately so that the reader will have no difficulty. The horizontal line for each type will be shown.

Each example will show the construction of the lines representing the path

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	—23 2	—17 9	—7 39	+ 4 28	+15 1	+22 2	+23 8	+18 5	+8 22	— 3 6	—14 22	—21 47
2	22 56	16 52	7 16	4 51	15 19	22 10	23 4	17 50	8 0	3 29	14 41	21 56
3	22 51	16 34	6 53	5 14	15 37	22 18	22 59	17 34	7 38	3 53	15 0	22 5
4	22 45	16 17	6 31	5 37	15 54	22 25	22 54	17 19	7 16	4 16	15 19	22 13
5	22 38	15 59	6 7	6 0	16 12	22 32	22 49	17 3	6 54	4 39	15 37	22 21
6	—22 31	—15 40	—5 44	+ 6 23	+16 29	+22 38	+22 43	+16 46	+ 6 32	- 5 2	—15 56	—22 29
7	22 24	15 22	5 21	6 45	16 46	22 44	22 37	16 30	6 9	5 25	16 14	22 36
8	22 16	15 3	4 58	7 8	17 2	22 50	22 31	16 13	5 47	5 48	16 31	22 42
9	22 8	14 44	4 34	7 30	17 18	22 55	22 24	15 56	5 24	6 11	16 49	22 49
10	21 59	14 24	4 11	7 52	17 34	23 0	22 16	15 38	5 1	6 34	17 6	22 54
11	—21 50	—14 5	—3 47	+ 8 15	+17 50	+23 5	+22 9	+15 21	+4 39	— 6 57	—17 22	- 22 59
12	21 41	13 45	3 24	8 37	18 5	23 9	22 1	15 3	4 16	7 19	17 39	23 4
13	21 31	13 25	3 0	8 59	18 20	23 12	21 52	14 45	3 53	7 42	17 55	23 9
14	21 20	13 5	2 36	9 20	18 35	23 16	21 43	14 26	3 30	8 4	18 11	23 13
15	21 10	12 44	2 13	9 42	18 49	23 19	21 34	14 8	3 7	8 27	18 26	23 16
16	—20 58	—12 24	—1 49	+10 3	+19 3	+23 21	+21 25	+13 49	+2 44	— 8 49	—18 42	—23 19
17	20 47	12 3	1 25	10 24	19 17	23 23	21 15	13 30	2 21	9 11	18 57	23 22
18	20 35	11 42	1 2	10 45	19 31	23 25	21 4	13 11	1 57	9 33	19 11	23 24
19	20 23	11 20	0 38	11 6	19 44	23 26	20 54	12 51	1 34	9 54	19 25	23 25
20	20 10	10 59	—0 14	11 27	19 56	23 26	20 43	12 32	1 11	10 16	19 39	23 26
21	—19 57	—10 37	+0 10	+11 48	+20 9	+23 27	+20 31	+12 12	+ 0 47	—10 38	—19 53	—23 27
22	19 43	10 16	0 33	12 8	20 21	23 27	20 20	11 52	0 24	10 59	20 6	23 27
23	19 29	9 54	0 57	12 28	20 33	23 26	20 8	11 32	+0 1	11 20	20 19	23 27
24	19 15	9 32	1 21	12 48	20 44	23 26	19 55	11 11	—0 23	11 41	20 31	23 26
25	19 0	9 9	1 44	13 8	20 55	23 24	19 43	10 51	0 46	12 2	20 43	23 25
26	—18 46	— 8 47	+2 8	+13 27	+21 6	+23 23	+19 30	+10 30	—1 9	—12 23	—20 55	—23 23
27	18 30	8 25	2 31	13 46	21 16	23 21	19 16	10 9	1 33	12 43	21 6	23 21
28	18 15	8 2	2 55	14 5	21 26	23 18	19 3	9 48	1 56	13 3	21 17	23 18
29	17 59	— —	3 18	14 24	21 35	23 15	18 49	9 27	2 20	13 23	21 27	23 15
30	17 43	— —	3 42	14 43	21 45	23 12	18 34	9 5	2 43	13 43	21 37	23 11
31	—17 26	— —	+4 5	— —	+21 53	— —	+18 20	+ 8 44	— —	—14 3	— —	—23 7

A table of the declination of the sun for each day of the year, at apparent noon. Equinoxes and solstices in bold type. Compiled from American Ephemeris

of the shadow cast by the nodus when the sun has a declination of 0°, and when the sun reaches its greatest northern and southern declination. The first is often referred to as the equinoctial line because, when the shadow of the nodus falls upon it, the sun is at the equinoxes, marking the beginning of spring and fall when the day and night are said to be of equal length.

The lines showing the sun's greatest northern and southern declination were called the tropics; and on old dials were labelled the Tropic of Cancer and Capricorn, respectively. They note the longest day (beginning of summer) and the shortest day (beginning of winter) of the year. These lines may also be referred to as limiting lines, for between them all other lines of declination must fall.

THE following are the instructions for the construction of the lines of declination on the equatorial dial. (Note: Obviously, in all types of dials, the size, shape, and all the parts must be known, before the lines of declination are constructed.)

Since the plane of the equatorial dial lies in the plane of the celestial equator, it is evident that all of the lines of declination cannot be placed upon it. When the sun has a declination of 0° the shadow of the nodus will not fall upon the dial; and when the sun is south of the equator no shadow will be cast upon the upper or north face.

If the location of the shadow of the nodus were marked when it reached each hour line throughout any particu-

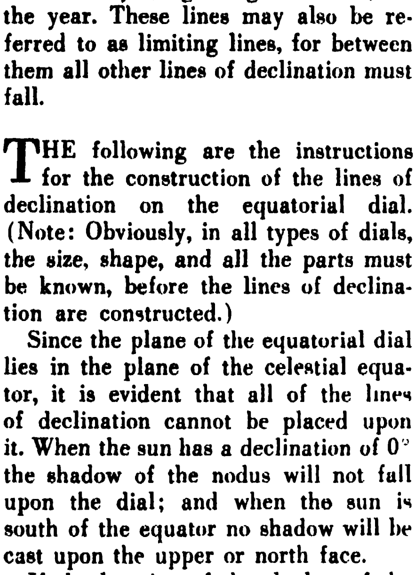


Figure 1

lar day, and a line drawn through those points, a portion of a circle would result, with the foot of the perpendicular style as its center. For this reason it is much easier to draw the lines on an equatorial dial than on other types.

In Figure 1, AB represents the plane of the horizon, CD the dial plate, N the nodus, MN the height of the perpendicular style, and M the foot of the perpendicular style.

For the horizontal line: Through N draw EF parallel to AB, intersecting CD at P. (Angle PNM is equal to the latitude of the place—in this case 45°.)

Take the distance MP and lay it off from the foot of the perpendicular style M (Figure 2) to Q, on the 12 o'clock line. Through Q, same figure, draw the line PR perpendicular to the 12 o'clock line.

Then PR will be the horizontal line for this dial.

FOR the lines of declination: Since the equinoxes cannot be shown on an equatorial dial, the line of declination for April 19 will be substituted.

From the table the greatest northern declination is found to be 23°27′, on June 21; and 11°6′ north on April 19.

Then, in Figure 1, draw the line GH parallel to CD. This represents the plane of the celestial equator.

With a protractor lay off the angle $GNV = 11°6'$ north; and the angle $GNT = 23°27'$ north.

Produce the lines VN and TN until they cut the dial plate, as at X and U.

Now take the distances MU and MX, and lay them off from the foot of the perpendicular style M (Figure 2), to T and W, respectively.

With M as a center and radii MT and MW, describe the arcs STU and VWX, respectively. Thus will STU and VWX be the desired lines of declination.

For all other lines of declination repeat the work precisely as shown.

WHAT time will the sun rise, when the sun reaches its greatest northern declination, on June 21?

In Figure 2, the arc STU represents the path of the shadow cast by the nodus on June 21. This arc cuts the horizontal line PR at U. U lies between the hours of 4 and 5 in the morning.

Estimate the distance from the point where the hour line of 4 crosses the horizontal line, to the point at U. This will be found to be about 10 minutes. Therefore, the sun will rise at 4:10 A.M. apparent time, on June 21, in 45° north latitude. This time may be converted into Standard Time by the method described in the preceding article. According to an almanac, computed for 45° north latitude, the sun will rise on June 21, at 4:12 A.M., apparent time. The reading of the dial compares favorably with the almanac.

Likewise, the time of sunset may be obtained.

THE Zodiac is a zone in the sky 16° wide (8° on either side of the ecliptic) in or near which the planets and sun appear to move. Beginning at the point on the ecliptic, which marks the position of the sun at the vernal equinox, this zone or belt is divided into 12 parts of 30° each, called signs. The signs derive their names from the constellations with which they coincided, about

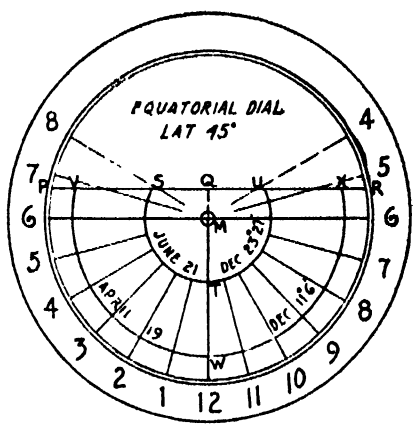


Figure 2

2000 years ago (today, shifted about 30°).

The lines of declination noting the entrance of the sun into the various signs meant much to the ancients, who were well acquainted with the meanings and omens attached to each. These lines are found on many old dials and they were referred to as the arcs of the signs, by early diallists. The entrance of the sun into the sign of Aries marked the beginning of spring; its entrance into the sign of Cancer marked the beginning of summer, and so on.

The present-day usefulness of the dial would be increased if the names of the constellations were inscribed upon it, as well as the attendant signs. In order to do this, find the date upon which the sun enters a constellation or sign. From the table observe the declination of the sun on that day. Then proceed, as described above, to plot the line of declination for that day on the dial plate. Place the symbol or name of the sign or constellation at the extremities of the line.

One must not lose sight of the fact that, because of the precession (retrograde motion) of the equinoxes along the ecliptic, each sign has moved backward 30°, into the constellation west of it, so that today the sign of Aries is in the constellation of Pisces, and so on. The signs are independent and they have no connection with the position of the sun in the constellations.

●

The construction of the lines of declination for dials whose planes lie oblique to the axis of the earth will be described in the next article.

●

NOTE BY AUTHORS: The paragraph reading "The sun . . ." and so on, page 198 of the April number, middle column, should be corrected to read: "Except for the few months of summer between the equinoxes (when the sun has a northern declination) the sun will not shine upon this dial between 6 A.M. and 6 P.M. Therefore, on a pillar dial it is necessary . . ." and so on.

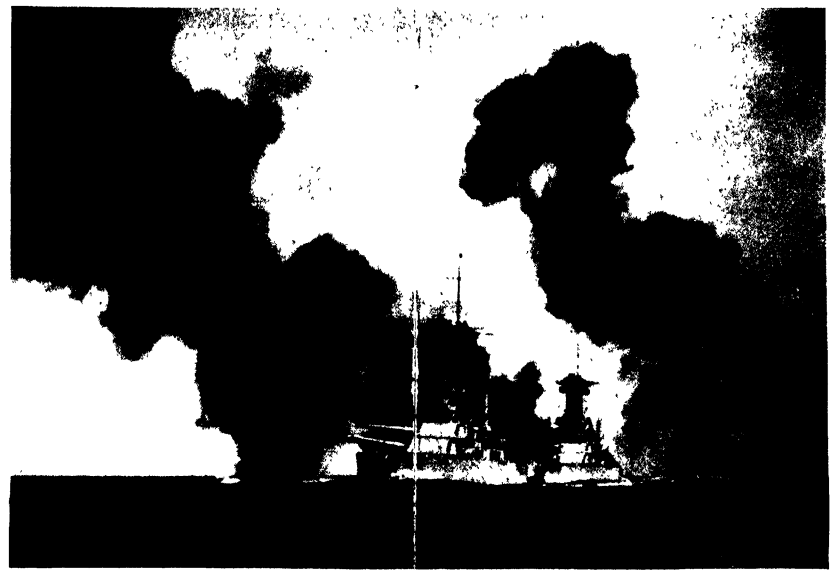
WHY THE BATTLESHIP?

Concluding Article of a Two-Part Discussion on the Battleship as a Necessary Naval Unit

By JONAS H. INGRAM
Commander, U. S Navy

The battleship is the very backbone of our sea power.

Claude A. Swanson



WHILE it really takes a war—the real test to prove most military contentions, there has been so much experimentation along all lines that technical experts are unanimous in their belief that the old bulldog, the battleship, has no superior afloat when it comes to giving and taking punishment; and, after all, upon this ability of a fleet rests the decision of the issue which is so vital to the nation and its defenses.

While the cost of a battleship is large in comparison with that of smaller types of surface vessels, there is grave doubt that there would be any economy in a lighter type. With reduction of protection comes greater vulnerability. One shell or one bomb in a vital spot in the cruiser type and a great loss is at once sustained. On the other hand, the battleship will undoubtedly take much punishment and still be able to carry on for a great period of time.

The main assault upon the surface ship has come from enthusiastic exponents of aviation. Doubtless the opinions of some have been given with all sincerity, and some of their assertions are grounded on fact. But in general the subject is presented in a form which is entirely misleading. Statements such as "Why build a mighty battleship to be destroyed by one plane?" or "How Cuba could drive our whole Navy from her coasts with an effective air force!" and "Why a Navy, when Italy could bomb New York City and Chicago by sending over General Balbo with his air squadrons?" are absurd, though they catch the eye. They will not withstand a common-sense analysis of fact, nor can they be substantiated by experience or the real test in actual warfare.

The history of warfare has shown that for every offensive weapon an effective defense has been devised. In the World War everything known to science from air barrages to poison gas—was tried, but the decision was usually arrived at by the doughboy himself, using effectively the two most primitive of weapons, the bayonet, or his rifle as a club.

FIFTEEN years ago bombers could, under picked conditions, unmolested and unopposed, undoubtedly sink a surface vessel. Under the same conditions, but with more difficulty, they could accomplish the same thing today. Yet in the meantime naval construction has advanced and means have been devised to lessen the vulnerability of ships to direct hits from bombs, by heavy horizontal protective decks covering all vital spots Huge blisters, or extending compartments on the sides below and above the water line have been added to protect against bombs that are not direct hits, that explode close enough to the ship to cause damage. In addition, the effectiveness of the anti-aircraft batteries is not to be discounted. There remains the most effective form of defense against aircraft the aircraft themselves The fleet is always accompanied by swift plane carriers with squadrons of fast fighting planes that are capable of taking to the air with great rapidity and would be most effective against the slower and heavier enemy bomber

History repeats itself in that the ingenuity of man always rises to provide an effective defense to any offensive weapon. During the World War the North Sea was an ideal place for submarine and mining operations. Both took their toll of British ships during the early stages of the war. Then paravanes, that ripped out mines and made them impotent, were devised and attached to heavy surface ships. Destroyer screening operations and depth bombs were developed to fight the submarine and, as a consequence, the British Grand Fleet swept this limited area, which was infested with hostile mines and submarines, suffering but negligible loss.

The naval expert today feels that the fleet has ample protection from enemy aircraft. Means have been devised to combat air attacks with a fair margin of safety.

The Air Forces of the Navy have been developed to a particularly high state of efficiency. There has been intelligent and active co-operation between commanders of the air and surface forces to provide sound and adequate defense from hostile air attack. This important question is continually under advisement and each big maneuver develops something new in making our Fleet a more effective and efficient first line of defense.

While there has been a marked advancement in aircraft during the past 15 years, the situation remains the same in respect to the possibility of air raids on this country launched from either Europe or Asia. It will be many years before an air squadron, loaded with effective bombs and necessary fuel, can negotiate the great expanse of sea and still do us much harm. The only avenue from which we are susceptible to air attack will be through planes carried on surface ships or located at advanced bases. In either case this is a problem for the Navy, and in this problem command of the sea will play an important part. Effective raids by air and successful blockades to our shipping can only be carried out when we have relinquished command of the sea, and naturally will be most difficult of accomplishment so long as our battle line remains intact.

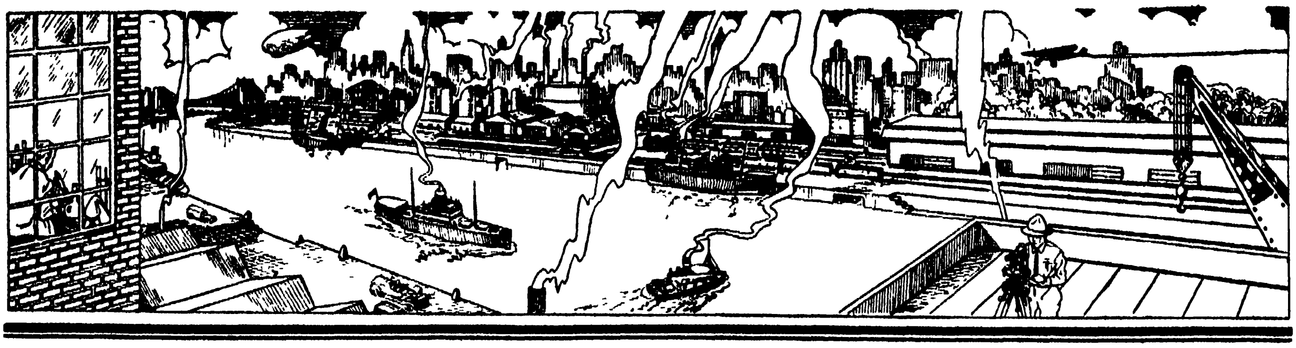
From a technical standpoint the naval constructor faces a difficult situation in the design of a warship to embody the following qualities: (1) Structural strength, (2) Nautical qualities; (3) Radius of action, (4) Armament; (5) Protection; (6) Underwater protection; (7) Aircraft protection; (8) Speed; and (9) Habitability.

That it must embody so many qualifications to perform its functions is the explanation of its size and power. Although the battleship costs less per ton to build and to operate than any other man-of-war, cost has not been a deciding factor in past construction. Obviously the battleship must be the most powerful type afloat. The larger it is, the better it can be safeguarded from air, surface, and submarine attack. Its main armament must be superior to that of any other type of vessel and should be capable of effective fire at extreme ranges. Vertical armor, adequate to keep out the projectiles of a size corresponding to those fired by her own guns, must be fitted

There must be an armored deck of sufficient thickness to keep out aircraft bombs and projectiles fired at long range. The damage caused by torpedoes, mines, and aircraft bombs exploding under water alongside the ship must be localized and restricted by an intricate system of subdivision of the underwater body. Neglect of any of these characteristics makes the ship vulnerable to some form of attack. A progressive reduction in size would reach a point at which the necessity for a large cruising radius in the case of powers lacking bases would force on them a sacrifice in the fighting characteristics of their capital ships as compared to those of other powers possessing a chain of bases. The restriction of capital ships to a small displacement, in effect making them powerful cruisers, would render them incapable of performing the functions previously described and would vastly increase the relative importance of merchant vessels converted to fighting ships.

EXPERIENCE leads us to the confident belief that vessels of the battleship class can, in an emergency, be maintained in a safe and economical operating condition for 40 years from date of completion, which is not true of vessels of intermediate size due to their lighter construction, for the very reason that the lighter ships are necessarily of much lighter construction filled with high speed machinery, and under service conditions will deteriorate much faster than the larger ship.

In speaking of displacement, this



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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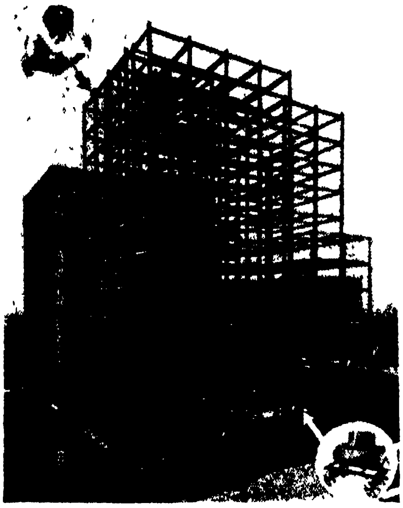
Remote Control for Arc Welders Cuts Costs

SAVINGS up to 500 dollars per year per welder—higher quality welds—increased weld output—these are results claimed for a new remote control device for arc-welding machines announced by The Lincoln Electric Company. No additional cables or other apparatus need be carried by the operator.

With this device, known as "Lincontrol," the operator taps the electrode on the work



Using remote-control arc welding in fabrication of a tall building

several times—the voltage is automatically raised! A larger number of taps and the voltage is lowered! Thus by merely tapping the electrode—making and breaking the electrical circuit—the current output of the generator is controlled.

With "Lincontrol" the operator can work at any distance from the machine and regulate the current accurately without making trips back and forth to adjust the controls.

When work is begun in the morning, the welder is cold. After the machine is warmed up the current setting should be changed. Without remote control, the operator either uses the original setting with resultant lower speeds or makes a trip to the machine, thereby wasting time. Changing from horizontal to vertical welding or vice versa demands a change in electrode size. If the operator is working in the hold of a ship, for example, this change, requiring a resetting of the controls, probably means many minutes of lost time.

In shipyard work, the average welding operator spends approximately 15 percent of his time in actual welding. "Lincontrol" increases the operating factor as much as 100 percent, according to the manufacturer.

There is a definite and substantial saving in time wherever welding is done at a distance from the machines, as in the case of shipyard and structural work, boiler and tank shops, pipe lines, steel mill work, and dozens of other applications.

Silver Soap

IN view of the social triumphs that the ad writers are attributing to the use of certain soaps these days, we can't help wondering what marvelous results they will conjure up for a newly patented soap containing metallic silver as a germicide—if it is ever put on the market. According to the patent specifications, the silver soap disinfects without discoloring. The silver is incorporated as powder, foil, leaves, or flakes and is then "activated" by superficial electrolytic oxidation or by treatment with hydrogen peroxide, permanganate, or other oxidizing agents. Soluble or difficultly soluble silver compounds, and sodium perborate, sodium pyrophosphate, peroxide, or other substances containing active oxygen may also be added.—*A. E. B.*

Warming Up the Rifle

INSTRUCTIONS for the sighting-in of hunting and target rifles, writes Louis Schauppner in *The American Rifleman*, usually designate that the sighting-in should be done "after firing warming shots." Mr. Schauppner relates some of his experiences with warming shots and reaches the conclusion that sighting-in of target rifles should be done after warming up the gun but that hunting rifles should be sighted-in without warming shots. He relates an interesting series of experiments which he conducted shooting prairie dogs, which showed that at about 80 yards range a cold rifle barrel placed shots about one inch low at seven o'clock. After six or seven shots, the point of impact raised so that the bullets were hitting the point of aim.

Since the hunting rifle is ordinarily used for only a comparatively few shots during the day, it appears logical, therefore, to sight-in the rifle with a cold barrel, as practically every shot will be fired under similar conditions. On the target range, on the other hand, shots are fired in rapid succession so that the barrel warms up; checking up of the sights for target work should, therefore, be done with a warm barrel.

Automatic Radio Tuning

A RADIO set which tunes in different stations according to a pre-selected schedule, starting and stopping and changing automatically over a 12-hour period, has been perfected by A. Atwater Kent, radio engineer and manufacturer.

Once set, the "tune-o-matic" receiver provides any combination of programs desired, and after turning itself off at night will go on again in the morning and serve as an alarm clock. It looks like any other large all-wave radio except for an electric clock set into the front panel. While the mechanism is described as a complicated problem in radio engineering, the operation is simple.

A series of small holes around the edge of the clock's face mark the quarter hour periods and serve as connecting channels between the time-clock arrangement and

How cords are used to "pre-set" the new automatic radio receiver

the tuning mechanism. The latter has 16 outlets in the form of miniature telephone switchboard cords, two to each of seven stations and providing for fourteen different program periods, with two extra cords for intermission periods. The cords are plugged into the holes at the desired program periods, and the radio then operates automatically, shifting from station to station and program to program, stopping itself and starting again exactly as scheduled. If the self-tuning mechanism is not turned on, the set operates like any other.

Bread Frozen—Still Fresh When Thawed

FREEZING bread with dry ice to keep it fresh is the latest trick of the baker's art, reported to the German science journal, *Die Umschau*. When the bread is thawed out again it is as good as new, it is claimed. A patent on the process has been applied for.

"Scientific American" Model Plane Prizes Awarded

AT the 1934 National Championship Model Airplane Meet, held in Akron, Ohio, June 27-29, prizes of three yearly subscriptions to SCIENTIFIC AMERICAN were awarded to the following successful contestants in the Indoor Stick Model Contest for contestants 21 years of age and over:

Carl Goldberg, Madison, Wisconsin, flew his indoor stick model for a world's record of 22 minutes, 54.6 seconds. This flight was inside the Goodyear-Zeppelin Airdock where all indoor flying was conducted. His model has a wing area of 150 square inches and span of 40 inches. The propeller's diameter is about 16 inches. The wing and empennage is covered with microfilm. The model's total weight, including rubber motor, is .165 ounce. This flight was all pure self-propelled flight, no thermal currents or soaring, just plain powered flying for almost 23 minutes. The motor is a single loop of rubber strand 7/64 by 1/32 of an inch. The length of rubber is about 36 inches and the ends are tied together to form a loop.

Mr. Ernest A. Whalen and Mr. Donald Lockwood were awarded the other subscriptions on the basis of having placed second and third in the same contest (indoor stick model) and showed an all-around performance in other events.

These annual meets are for National Aeronautic Association junior and senior members only. There are several thousand such members who fly model airplanes. The records are given official status by virtue of the Association's affiliation with the Federation Aeronautique Internationale.

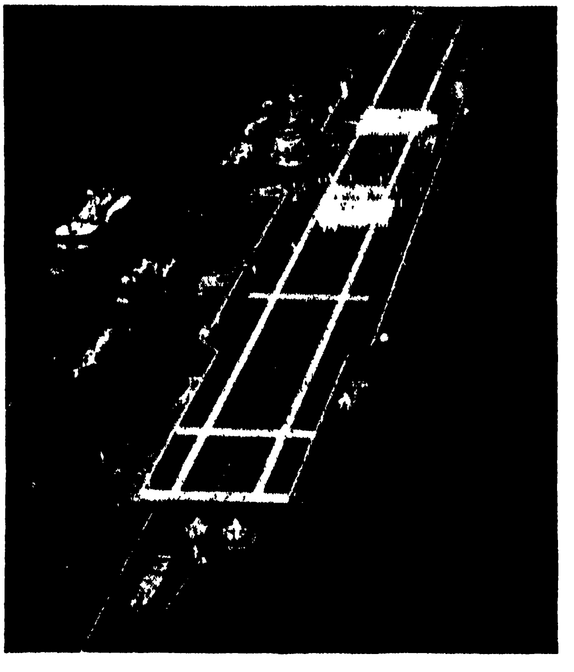
Too Many Chemists?

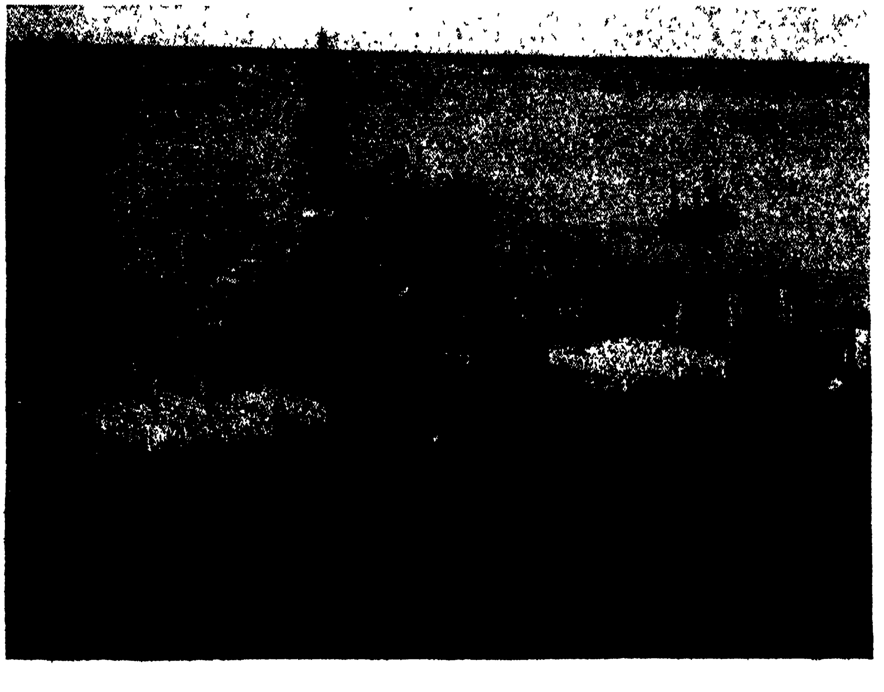
"ARE there too many chemists?" asks the editor of *Industrial and Engineering Chemistry*. Faced by the fact that many college trained chemists are out of work and that more and more young men and women are studying to become chemists, members of the profession are wondering whether industry will be able to absorb the supply. *Industrial and Engineering Chemistry* points out that "we have 160,605 lawyers, judges, and justices; 153,803 physicians and surgeons; 22,000 architects; 61,905 college presidents and professors; 71,055 dentists, 102,086 civil engineers and surveyors; 57,837 electrical engineers; 54,346 mechanical engineers; 11,970 mining engineers; 29,613 librarians; and under the broad classification of chemists, assayers, and metallurgists, 37,068. All of these occupations appear overcrowded.

"Last year, 417 people received the doctor's degree in chemistry; probably a minimum of 7000 received the degree of B.S. majoring in chemistry. There are no doubt as many as 30,000 in our institutions of advanced learning with chemistry as a primary interest. It is unlikely that all of these people will find places satisfactory to them for the practice of chemistry."

In spite of the fact that there seems to be no prospect of satisfactory jobs for all these chemists, the fact remains that employers have difficulty, even today, in finding the kind of men they want for chemical jobs. The chemist who has specialized in some particular phase of his science, who has delved a little deeper than anyone else into his chosen subject and who has developed ideas of his own for improving products or reducing production costs is not likely to be unemployed very long.

Young men and women considering a career in chemistry should realize in advance that being a chemist gives no guarantee of a job but that there will always be rewards for the few who can stand out from the crowd in ability and in willingness to work.—*A. E. B.*





Our newest aircraft carrier, *Ranger*, first American ship to be designed from the keel up as a carrier. These two views show some features that differ from our other carriers. *Ranger* is of 13,800-ton displacement, is 727 feet long, and carries 72 planes of various kinds. Two other new ones, *Enterprise* and *Yorktown*, are now under construction

Quality in Eggs

AN actual test with results measured scientifically has again disproved a notion or opinion widely held. Some poultrymen have believed that it was possible to overdo efforts to breed a strain of poultry capable of high records in egg laying. They said that the greater number of eggs a hen lays the poorer the quality of the eggs. Poultry

Equipment used in measuring ultra-violet radiation by the "cupful"

specialists of the United States Department of Agriculture had no evidence to substantiate this idea, but the idea was important if true. So they investigated.

It is recognized that the proportion of thick albumen in relation to thin albumen in the white of an egg is one of the reliable indicators of egg quality. Eggs with a high proportion of thick albumen stand storage better, and they fry or poach better when fresh. The result of actual tests showed that there was no relation between the number of eggs a hen laid and the proportion of thick albumen in the eggs. Some of the heavy layers produced eggs with a high proportion of thick albumen, whereas others produced eggs with a smaller proportion. This was also true of the hens that laid relatively few eggs.

The investigators found that there are individual and breed differences in quality as well as in quantity of eggs. They suggest, as a consequence, that it may prove possible to select strains of poultry that lay quality eggs with a high percentage of thick albumen. Whether it would pay to do so would depend on marketing arrangements that would insure a premium price for quality.

Ultra-Violet Measured by "Cupful"

A NEW ultra-violet meter that "tunes in the sun," and, upon selecting a band of radiation, measures its biologically-effective ultra-violet content by the "cupful," has been developed by Dr. M. Luckiesh and A. H. Taylor.

The new meter is encased in a small portable cabinet, approximately eight by ten by seven inches in size. It is equipped with a photo-electric cell which is connected to the meter by means of an extension wire. Inside of the cabinet is a vacuum tube hooked up with a sensitive counting relay which is similar in appearance to the odometer of an automobile.

In operation, the photo-electric cell, when actuated by the ultra-violet radiation, passes a small current which accumulates on a condenser until it reaches a sufficient quantity to "spill over" and turn the counting relay. This process is repeated as long as the photo-electric cell is exposed.

The new meter is being used at Nela Park to measure the ultra-violet output of Sunlamps. Being portable, it can be used by anyone, anywhere, for similar measurement. Physicians, for example, may use the instrument to measure the exact amount of ultra-violet they give their patients.

Cities that advertise the relative health-merits of their climates may now easily announce the average amounts of beneficial ultra-violet they receive in the course of a month, year, or period of years. For example, Miami and Los Angeles might announce the comparative amounts of ultra-violet received over a given period.

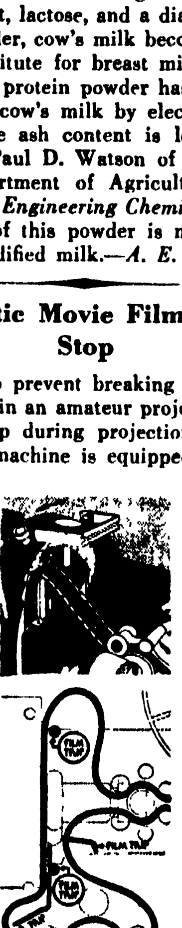
Dialyzing Milk

COW'S milk in an infant's stomach forms curds which are larger and harder to digest than breast milk. Also it is deficient in lactalbumin or whey protein, held to be essential for infant growth. By adding water, fat, lactose, and a dialyzed whey protein powder, cow's milk becomes an improved substitute for breast milk.

The whey protein powder has been produced from cow's milk by electro-dialysis, in which the ash content is lowered, according to Paul D. Watson of the United States Department of Agriculture in *Industrial and Engineering Chemistry.* About 30 percent of this powder is necessary in properly modified milk.—*A. E. B.*

Automatic Movie Film Safety Stop

IN order to prevent breaking motion picture film in an amateur projector due to losing a loop during projection, the Animatophone machine is equipped with four



Mechanism that stops the film in a movie projector before breakage

automatic film trips which stop the machine before any damage can be done. The accompanying illustration shows how this is accomplished. If at any one of the four points indicated the film pulls against an automatic trip, a clutch lever is immediately thrown out of operating position, cutting off both power and light.

Perfumed Gasoline

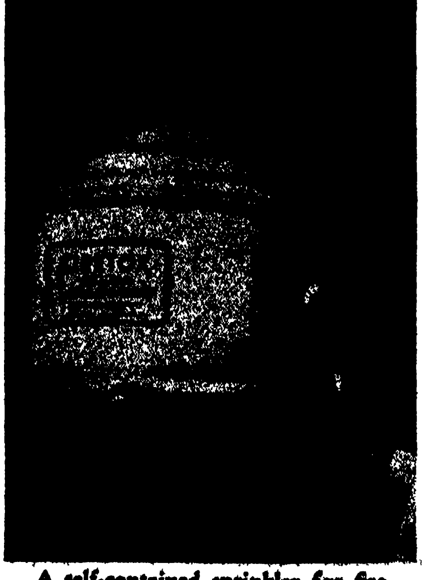
IN spite of their energetic claims that their gasolines will impart stream-line action to your old car or lift the pyramids a couple of feet, it appears that our gasoline companies have been missing a trick, for it is now possible to "doctor up" the motor fuel so as to eliminate the odor of exhaust gases. Just imagine the possibilities in advertising a gasoline that will leave behind the sweet perfume of gardenia or lilac as you drive through the city!

The process for ameliorating the smell of the exhaust gases of internal combustion engines is covered in a recent patent which claims that an agreeable smell can be imparted to the exhaust gases of internal combustion engines using any desired type of fuel by adding small amounts, four grams or less per gallon, of an artificial musk compound or an arylalkylketone. Both substances have the property of resisting combustion under the conditions prevailing in internal-combustion engines and are adapted to impart to the exhaust gases a pleasant odor which enables the pungent smell of the half burned oil to be modified as desired.—*A. E. B.*

Self-Contained Sprinkler

MAXIMUM protection at minimum cost characterizes a new automatic chemical sprinkler system for use in factories, warehouses, stores, schools, hospitals, basements of dwellings, and other places now without sprinkler protection. In water sprinkled plants, the system may be installed in remote spaces or for special hazards such as paint and lacquer rooms, or in storerooms and vaults requiring special protection not only from fire but water and chemical damage as well. The system is particularly attractive for buildings beyond public water mains, as well as for galley and engine room of pleasure craft.

The Firetox system comprises one or more aluminum units suspended from the ceiling and providing protection for a given number of cubic feet of space. Should a fire occur within the area protected by a unit, the excessive heat develops a pressure within the unit and melts the low-melting-point solder of its sprinkler head. This releases under pressure a chemical spray which, in contact with heated air, becomes a non-poisonous gas blanket five times heavier than air. This gas blanket settles down on the blazing area and, by diluting the oxy-



A self-contained sprinkler for fire protection, showing its small size

gen, extinguishes the fire without water or chemical damage. No piping is necessary. The units are entirely self-contained and fully automatic.

Numerous tests and actual fires indicate that these units operate within two or three minutes of the start of a fire in the protected area. The fire is mastered in a few minutes. Necessary listing and approval have been obtained from Underwriters' Laboratories and Factory Mutual Laboratories for use under conditions specified.

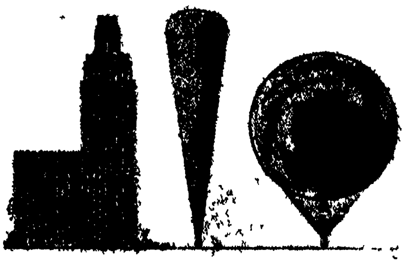
Aids for Stratosphere Flight

THE newspapers have given the public more than adequate information on the plans and prospects of the stratosphere flight by Major W. E. Kepner and Captain A. W. Stevens, under the auspices of the National Geographic Society and the Army Air Corps. We would like to give our readers a photographic view of some of the devices and methods that are an integral part of the expedition which, at the time of writing, is waiting favorable weather for the take-off.

The balloon is the world's largest, and has a capacity of 3,000,000 cubic feet. Its top will be at a distance of 300 feet from the gondola. The gas release valve must of necessity be placed at the top of the balloon, where it will have the greatest chance of rapid release. Therefore, to open the valve at the top of the balloon by means of a rope does not seem very practical, since there is a possibility that the rope might become tangled. Accordingly, Captain Stevens has invented a special compression valve to release hydrogen gas from the bag. A rubber hose will extend between the gondola and the top of the balloon. Compressed gas admitted to the rubber hose will open the valve by exerting pressure on it against the action of a spring. The design of such a valve is a very delicate affair. The valve must not only open against the action of the spring and on the admission of the compressed air, but it must also shut absolutely tight when the pressure is turned off, and the setting of the valve in the comparatively flexible balloon is a matter which the engineers have worked out very carefully indeed.

The gondola is a metal sphere eight feet four inches in diameter, built up somewhat like the sections of an orange, of an alloy which is 95 percent magnesium. The shell, without its fittings and instruments, weighs 450 pounds. Photograph 4 shows the ball near completion at the factory of the Dow Chemical Company. The workers are attaching an air-tight hinged manhole cover. A second manhole is situated on the opposite side of the sphere. The small openings are observation portholes. The flyers will be sealed in with a supply of air, but the manholes can be quickly opened from within. The construction of the sphere from welded "orange peel" sections and two circular pole pieces is apparent in the photograph.

For navigational purposes it is important to know the temperature of the hydrogen gas in the balloon. Captain Stevens has accordingly devised an interesting instrument which will be placed in the bag and will be read through a window in the gondola. This consists of an inner and outer strip of metal having different coefficients of expansion. Under temperature influences the outer and inner strips will have different expansions, and accordingly will actuate the indicator, which the navigator will observe.



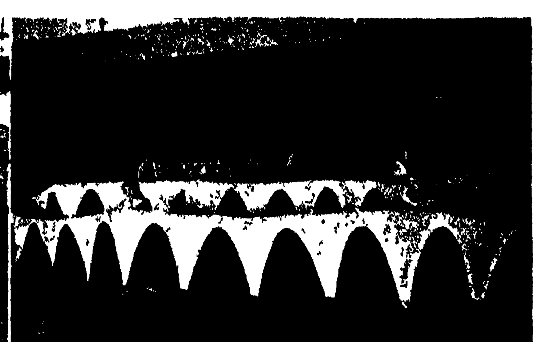
Center: **Balloon at start, and at** ***right,*** **the balloon fully extended**

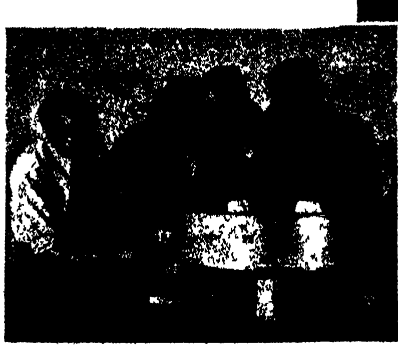
When leaving the ground the balloon will have the shape shown in one of the illustrations, between the tall building and the balloon in its circular form. It will, at that time, be less than one tenth filled with hydrogen, which will gradually expand as the balloon rises to the thinner and rarer air. When the balloon is ready to rise, its top will be more than 300 feet above the earth—higher than a 27-story office building. At the top of its flight, nearly 15 miles above sea level, the hydrogen will have fully expanded, and the balloon will have become a sphere 180 feet in diameter. It will then be large enough to enclose an 11-story cubical building.

No needles and thread were used by the balloon tailors. Sections of rubber-impregnated balloon-cloth are pasted together with rubber cement, and the seams are covered with rubber tape. These are necessary pre-

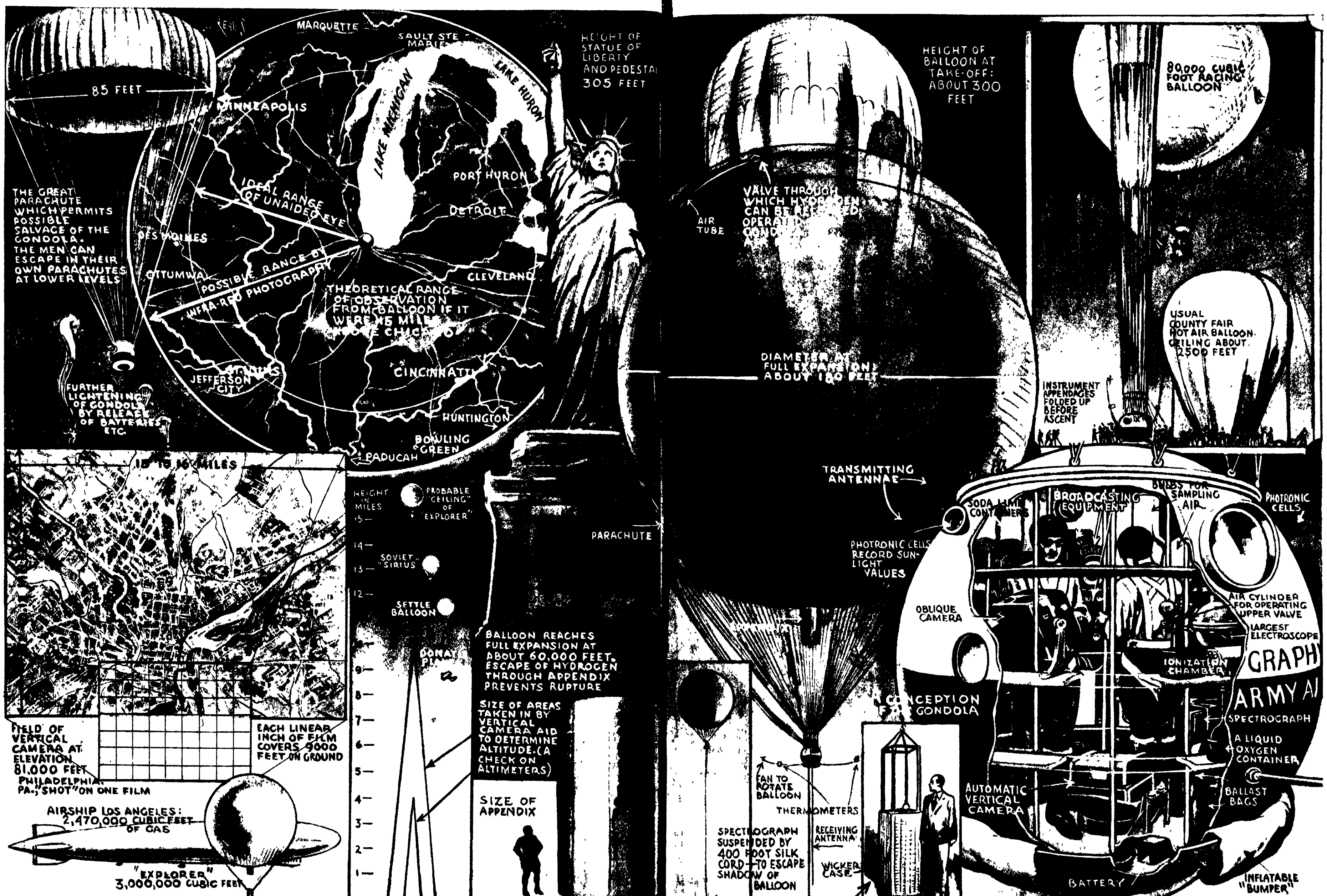
Major William E. Kepner
Captain Albert W. Stevens

● Other details of the stratosphere balloon are given in the two-page drawing on pages 148 and 149





Some of the details of the balloon designed for stratosphere flight. 1: Laying out the rip-panel. Note weights that hold the material in place. 2: From the scallops of the catenary band will hang the ropes that support the gondola. 3: Compression valve described in text. 4: Placing an air-tight manhole cover in the gondola. 5: Gas temperature indicator for the bag



Some of the details of the stratosphere balloon that is, at the time of writing, awaiting favorable weather for the take-off. Note particularly the tremendous range of observation possible at a height of 15 miles

cautions to avoid gas leakage. During this process the fabric is held in place, not by pins, but by 10-pound lead weights. When working on the cloth the workers wear cloth shoes to avoid grinding grit into the delicate surface. The cotton fabric used will cover three acres of surface. Two of the workers are shown, in photograph 1, holding a wedge-shaped panel with scalloped edges. This panel is the rip-cord, and will be torn out by the balloon pilot by jerking a rope just as the gondola reaches earth.

The gondola must, of course, be securely fastened to the outside of the balloon, and the "catenary band" shown in photograph 2 will be cemented as a belt around the balloon to distribute the load as much as possible. From each of the 160 scallops a rope will extend downward to form bridles that will support the gondola with its load of men, instruments, and ballast.—*A. K.*

A Circular Wing Airplane

TWO of our photographs illustrate a novel form of aircraft which is quite conventional for the most part, except that the regular airplane wing is replaced by a circular surface 15 feet in diameter. On the circular wing a rear flap is mounted, which, when depressed, helps to increase the maximum lift of the wing, just as on an airplane wing. At the tips are two movable surfaces which evidently act as ailerons. Steven P. Nemeth, the designer of the craft, informs us that with 110 horsepower a high speed of 135 miles per hour has been obtained, and that the low speed is satisfactory.

Our guess is that on the debit side there is likely to be much more induced drag than the ordinary airplane wing, because of the low aspect ratio and high tip or end losses. On the credit side there should be

Above and right: **Two views of the airplane with 15-foot circular wing**

a greatly delayed stalling point; that is to say, a stalling point much above the usual angle of incidence of 15 or 16 degrees. --*A. K.*

A Novel Amphibian Gear

OUR readers are, of course, familiar with amphibian gears in which some form of retractible wheel chassis is added to the flying boat hull or the seaplane floats. In Germany, a novel amphibian under-carriage has been produced in which large inflated balls of rubber are used instead of wheels.

Tests so far have been made only on land, and the light airplane has got off and landed fairly well. With big enough rubber balls there is no reason why there should not be sufficient flotation in the water, and no very great difficulty in alighting on the water.

In a water take-off, the water resistance will be much greater than that of the planing under-surface of a float. That is where this tempting simplification of the amphibian gear may fail.—*A. K.*

Air Liner Headlights

GONE are the days of projecting headlights on airplanes. On the new Boeing transport, landing lights are now completely enclosed, a compartment in the leading edge of the wing housing a locomotive-type, silvered glass headlight reflector, a special globe, and a courtesy light which shows red on the port side and green on the starboard side. The outer glass is curved, conforming to the wing contour.—*A. K.*

Headlight in an airplane wing

Bonding An Airplane

SOME useful tips on bonding an airplane are given by Rex Martin of the Department of Commerce in a recent issue of *Sportsman Pilot*. By bonding, of course, is meant electrically connecting together all metal parts of an airplane into one electrical mass. Some day bonding may be eliminated. At present it is quite impracticable to use radio effectively on ships which are unbonded.

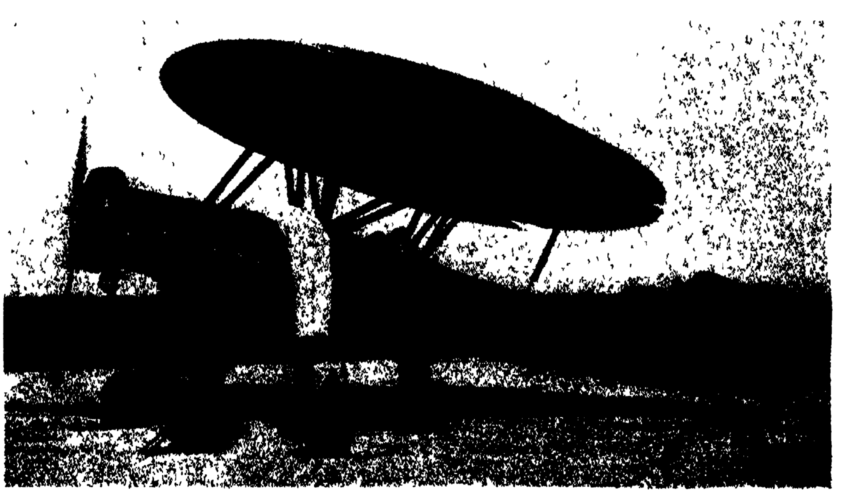
Mr. Martin gives the following five good reasons for bonding an airplane:

1. To increase the electrical capacity between the airplane and the antenna of the radio set.
2. To prevent absorption of the radiated energy of the radio set by metal parts which are electrically isolated from the main metal mass of the airplane.
3. To eliminate the danger of sparks between two metal members between which there exists a difference in electrical potential, caused by the collection of a static charge.
4. To eliminate noises produced in the radio receiver which are caused by the varying resistance between rubbing or vibrating metal parts.
5. To protect the radio shielding from electrical disturbances by lowering its resistance.

The bonding itself is simple in principle but lengthy in execution. For example, on wooden wings, a flat copper strip, not lighter than 1/64 by 1/4 of an inch should be attached by brass nails to the inside faces of the spars. A copper network is in fact formed, which connects to the metal fuselage. All the fittings, including strut fittings, drag strut and brass wire fittings, control hinges, and so on, are connected to this copper strip network. Particular importance attaches to the joints made by welding, soldering, and riveting. Control surfaces are bonded to the main metal mass of the structure by means of flexible braided copper wires. Wherever flexible cable is likely to come in contact with the network structure, insulation with fibre is provided. Oil tanks, gasoline tanks, and all plumbing are similarly bonded by braided connections across the hose connections.—*A. K.*

Laminated Paper Does Not Expand or Contract

THE Neenah Paper Company, in conjunction with Mr. Garrett B. Linderman, an engineer of Pittsburgh, has developed a new laminated paper which consists of two sheets of paper pasted to a center core of very thin aluminum foil. The metal foil in the center can be of other material besides aluminum, such as electrolytically deposited copper, or lead, though the widest application seems to lie at present in using aluminum foil as a center. This foil may vary in thickness from .005 of an inch either heavier or lighter, depending on the individual requirements.



By cementing the two sheets of paper to a center core of aluminum, it has been found that the paper will not expand or contract under varying humidity conditions, provided the correct adhesive is used. This makes the paper especially suitable for recording instruments, charts of various kinds, or for any purpose where extreme accuracy is demanded.

The development of special adhesives, which have been perfected, gives a waterproof adhesive and also a highly heat resistant adhesive.

Besides the instrument field itself, this paper has been used very successfully for topographical maps and other chart work where the expansion and contraction of a normal sheet of paper would cause decided inaccuracy.

One other field in which it seems that there should be great possibilities for this paper is in the making of architectural drawings with washes or for water-color prints where the problem of buckling is always present.

Adjustable Engine Cowling

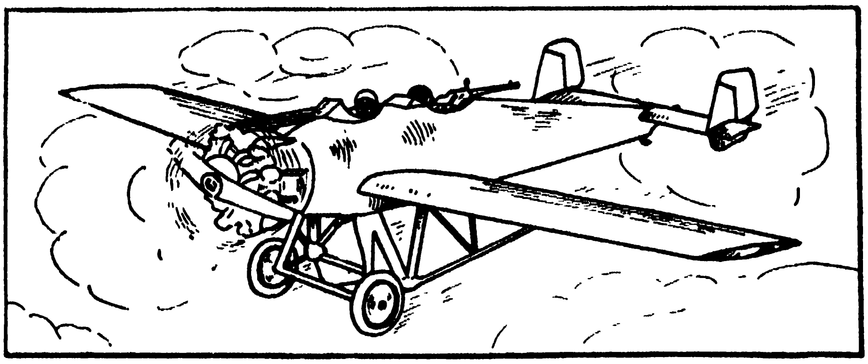
IN take-off or climb the air-cooled engine is working at full power while the airplane is moving forward at a comparatively low speed. For this condition, therefore, it would be desirable to have a large opening at the rear or exit end of the N.A.C.A. cowl which almost invariably protects the air-cooled engine from excessive head resistance. Otherwise the temperature of the engine will run too high.

On the other hand, at top speed in level flight, particularly at altitude, the same rear-end opening is not necessary for cooling; it could be cut down and thus save head resistance.

Starting with this simple argument the engineers of United Aircraft have designed and successfully tried out an adjustable cowling which enables all conditions to be met in the best possible manner, controls the engine temperature, and allows the top speed to be improved some six miles an hour.

The new adjustable cowl is shown in two of our photographs, applied to a large Pratt & Whitney motor. The device consists of a standard N.A.C.A. cowl having an adjustable trailing edge or skirt. This skirt is made up of a continuous series of metal flaps, pinned along their leading edges to the trailing edge of the cowl. These flaps are so connected to a manual control that they open fanwise, preserving a substantially unbroken cowl surface, but one which flares out decidedly at the trailing edge as the flaps open.

The extra weight is only 16 pounds, and the device has proved thoroughly worth while both in trial flights and wind-tunnel tests.—*A. K.*



Split tail surfaces make this plane a more effective fighting unit

"Dry Ice" in Machine Shop

SOLID carbon dioxide, popularly called "dry ice," may, at a temperature of 112 degrees below zero, Fahrenheit, compete with heat in securing "shrink fits" for machine parts.

W. H. Swanger of the National Bureau of Standards, who has been conducting experiments with solid carbon dioxide reports that machine shop practice may come to accept the new method of applying excessive cold instead of heat in shrinking metals.

When it is necessary to secure a metal band to a shaft, the usual practice is to heat the band. Expansion allows it to be slipped into place, and as it cools it contracts to a tight fit. However, by "refrigerating" the inside part, or shaft, it can be shrunk materially. The band is slipped on and when the shaft warms to room temperature it expands again to normal size, and a tight fit is secured.

Relatively a curiosity five years ago, the domestic production of frozen carbon dioxide has in recent years exceeded 40,000 tons. Now that it has become commercially available, Mr. Swanger believes that the shrinking of metals with excessively low temperature will be adopted as an engineering method, and will find extensive use. *Science Service.*

Firing Through the Tail Surfaces

THE classic maneuver in air fighting is to dive on the enemy's tail, where he cannot protect himself because the rudder hinders his firing to the rear.

In a Junkers two-seater fighter built in Sweden, this hazard of aerial combat is cleverly avoided. The rudder and fin are split up into two parts and mounted at the end of the horizontal tail surfaces. The rear gunner thus has ample range of fire to the rear. If such designs are generally adopted the aces will have to think up new methods of attack!—*A. K.*

Diphtheria Toxoid

THE Division of Laboratories and Research of the New York State Department of Health has discontinued the general distribution of diphtheria toxin-antitoxin mixture which it has continued to supply upon request since diphtheria toxoid was made available to physicians nearly two years ago. Experience accumulated during this period has demonstrated the superiority of toxoid. Immunity is acquired in a shorter time and the percentage immunized has been higher than with toxin-antitoxin mixture. Moreover, toxoid does not contain horse serum, so that there is no possibility of sensitization to subsequent injection of prophylactic or therapeutic preparations derived from the horse.

Toxin-antitoxin was a mixture of killed and unkilled germs, alternated and weakened in virulence by being run through the blood, generally, of horses. Toxoid is killed diphtheria germs.

Sodium Chlorate Weed-Killer

HOME gardeners as well as farmers and horticulturists will be interested in recent successful experiments with sodium chlorate as a weed-killer. Tests have been carried out by several different experimenters working independently, and all agree that the treatment is both effective and cheap. *Chemical Industries* reports that tests carried out at a temperature of 40 degrees, Centigrade, and soil humidity of 24 percent, show that the toxicity of sodium chlorate in the soil sinks to nil at the end of six weeks, while in a fresh and relatively dry soil the salt maintains its toxic properties for more than two years. Results in the wet soil are due to the decomposition of the chlorate with the liberation of oxygen and the production of sodium chloride. It has also been tried out in cereal cultivation in the endeavor to

The adjustable engine cowling, described above, closed and open

secure a comparison with sulfuric acid, with the finding that the chlorate process is more economical than the sulfuric acid, and easier to use.

From other literature it appears that a 10 percent solution (one pound per gallon of water) is required for the eradication of large grasses and docks; a 5 percent solution for herbaceous weeds and small grasses, while small annual weeds require a 2½ percent solution.—*A. E. B.*

Unemployment and Fertility

THE birth rate among wage-earning families who suffered serious loss of income on account of the depression was 39 percent higher in the period of 1929-32 than among their neighbors whose incomes were not reduced following 1929. These findings are reported in a recent issue of the *Milbank Memorial Fund Quarterly* by Edgar Sydenstricker, in charge of the foundation's division of public health activities, and G. St. J. Perrott, consultant to the United States Public Health Service, following a house-to-house investigation of occupation, employment, income, births and ill health in 8000 families in eight typical cities. The authors believe this study to be the first of its kind ever undertaken.

It is considered significant that families forced to shift from a higher to a lower income level were found to have a higher birth rate during the depression years than those families who were able to remain in the class from which the downward shift was made.—*Health News* (New York State Department of Health).

Gold from the Sky

SCIENCE'S first recorded discovery of gold that has fallen from the sky to the earth was reported by Dean Gillespie of Denver. This unique discovery was announced before the meeting of the American Association for the Advancement of Science.

A stony meteorite found near Melrose, New Mexico, was analyzed by H. G. Hawley of the Niniger Meteorite Laboratory in Denver. Minute amounts of gold were detected. Just to be sure, this unusual result was checked by an American Smelting and Refining Company assay.—*Science Service.*

Tear Gas Fountain Pen Held To Be "Pistol"

IN the case of People *versus* Anderson, 260 New York Supplement 329, Anderson was convicted in the Court of General Sessions for New York County of criminally having in his possession a firearm without a written license therefor, and appealed to the Supreme Court, Appellate Division, First Department.

The evidence disclosed that the alleged pistol had about the size and appearance of an ordinary fountain pen made of very heavy metal, without a butt, trigger, or sight, and about five inches long. It was equipped with a device which could be snapped like a trigger, and was primarily intended for the discharge of tear gas. The evidence further disclosed that bullets could be discharged from the device.

Associate Justice Martin delivered the opinion of the Appellate Division, affirming the conviction and holding that the device

was a "pistol" within Penal Law N. Y. § 1897, subd. 4.

His opinion, in part, is as follows:

"There may be a chemical explosion with gunpowder in the instrument here under consideration. There is combustion and those other elements present that constitute it a firearm. The language of the statute clearly intended to prohibit the possession, without a permit (Penal Law, supra), of an instrument such as this, for it provides 'any pistol, revolver or other firearm.' . . ."

If You Make "Dry Points" Professionally or for Fun

THIS is good news for the etcher who sallies forth with plates for a day's picture making. It's aluminum now for the dry-pointer! A third less weight to carry out; a third less to carry home.

The Alumilite process makes aluminum hard enough to last through many prints—one test plate running to over 600 impressions before showing signs of wear.

Artists find advantage too, in the color of the metal. It can be sketched upon just as if it were a piece of hard, smooth grey board. It will stand erasure perfectly. There is quite a story about this use of aluminum in the September, 1933, issue of *The Charette*—A Little Journal of Rejuvenation published every month by the Pittsburgh Architectural Club.

"Synthetic Rubber" Tires

THE "synthetic rubber" tire is now an accomplished fact! These relatively insignificant words tell a story of tremendous economic significance. They indicate the

Tires of "synthetic rubber" have the appearance of ordinary tires

successful solution of a long fight to insure for the United States a source of rubber goods and particularly tires which would make us independent of foreign producers of rubber in the event of a war. Uninterrupted movement of supplies, foodstuffs, and matériel of war would be vital to our national defense plans during war time and transportation would certainly be crippled were rubber tires not available.

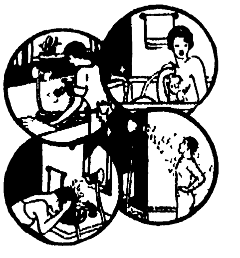
Tires made entirely of Du Prene, the so-called synthetic rubber developed by the duPont company and announced in SCIENTIFIC AMERICAN about two years ago, have been built by the Dayton Rubber Manufacturing Company, and severe tests have proved these as tough and durable as tires made of natural rubber.

This new tire is not to be considered a competitor in peace times of the tire made from the natural product. This could hardly be the case with plantation rubber costing only about one tenth the price of Du Prene. However, during war time one dollar or more per pound for Du Prene would not be a factor worth considering when the security of the nation is at issue.

Portable Bath Shower

A SHOWER spray that is compact, light in weight, and requires no permanent installation has recently appeared on the market. The shower, as shown in the illustrations, is provided with a large suction disk which permits it to be attached to any smooth flat surface. It can be used with any type of bath tub and can be placed at any desired height. Used as a spray for the shoulders and chest, it gives an invigorating shower without wetting the hair. Placed higher on the wall it serves the purpose of a standard overhead shower.

The portable feature of this shower makes it adaptable for other uses than in the bath. Attached to the wall or mirror over the wash bowl it can be used for shampooing the hair.



Right: **New portable shower, and *left,* drawing of four uses to which it can be put in the home**

This little unit weighs less than 1½ pounds and is equipped with a faucet connection which has been designed to permit use with almost any type of faucet.

Diabetic Children Not Retarded Mentally

CHILDREN suffering from diabetes and taking insulin for the control of that disease measure up in intelligence as equal to normal children, it was revealed by tests of 78 diabetic children reported to the American Association for the Advancement of Science by Dr. Howard West, Amytis Richey, and Mary B. Eyre, of Claremont College.

Re-tests after an interval of over eight weeks showed that, except for some exceptional cases, the individuals did not vary significantly in test score with variations in control of the disease.—*Science Service.*

Paint From Milk

WILL the cows still be "contented" when they discover that milk is being used as a raw material for paint? Casein paint has an advantage of high reflectivity, resulting in approximately the same effect under artificial illumination as in the daytime. Of course, casein (curd) has been precipitated from milk for years and made into a wide variety of moulded articles, but its use as a paint base is something of a novelty.

Says Arthur D. Little in his *Industrial Bulletin*: "Casein paints formerly were based on whiting and other low-grade pigments, but today the better grades contain the finest high-quality pigments. No longer are the coatings muddy and transparent when wet. The most advanced manufacturers now make this paint up in paste form, so that mixing for use is much quicker and easier than when the old fashioned powder was used. Some even mill the pigment and may combine a certain amount of oil with it. Highest-grade paints give extremely smooth coatings which dry rapid-

ly, without fume or odor, entirely flat and gloss-less.

"Because of the porosity of its films, casein paint is not recommended for the long-time protection of wood or metal, outdoors. This very porosity to water vapor is not always a disadvantage, however, for it permits casein paints to be applied to plaster while it is still wet, and does not interfere with the proper drying out of the plaster thereafter. Casein paints also have high lime-resistance, a rare quality in paints, so that they may be used over cement or lime mortar, even while these are still wet.

"Casein paints are not to be thought of as highly competitive with oil paints. The latter are best on smooth woodwork, and especially outdoors. Casein paints fill the great need of a decorative and light-reflecting paint which can be applied easily by brush or spray, early, and over even the roughest of materials. While not glossy, its surface is smooth and absolutely free from tackiness. It is singularly resistant to the accumulation and retention of dirt and grime, making this type of coating particularly suitable for use in cellars, warehouses, and factories, as well as for all temporary constructions."—*A. E. B.*

Chicken Feathers in Pens, Buttons, Insulators

CHICKEN feathers may come into the market disguised as fountain pens, buttons, and various novelties now made from other plastic materials if research carried on at Iowa State College becomes commercialized.

Immense quantities of chicken feathers are produced every year. Many of these are utilized in such well-known articles as pillows and feather beds but large quantities go to waste. These feathers may be dissolved in caustic soda and then thrown out of solution in a new form by acids. This new material may be molded to any shape and hardened by formaldehyde.

The finished material is said to be fairly hard, very elastic, an excellent electrical insulator, and resistant to water, heat, dilute acids, and alkalies. Somewhat similar plastics are being made commercially from milk casein.—*Science Service.*

Coin-Operated Time Switch

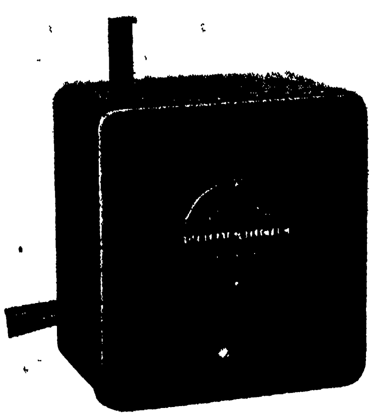
A NEW coin-operated time switch, specifically designed for connection between an electric refrigerator or similar device and the electric supply, has been announced by the General Electric Company. The purpose of the device is to disconnect the refrigerator or other device from the electric supply unless periodic stipulated payments are made into the coin switch.

It is not necessary to destroy the refrigerator service cable, or in any way mutilate it. Its plug is simply inserted in a receptacle within the coin switch; the cover of the switch is then locked against tampering. The plug of the time switch is then inserted in the usual wall or baseboard receptacle of the home.

Coins (25-cent pieces only) are credited by inserting them in a slot in the top of the switch and depressing the lever. Up to 15 coins can be credited in advance of use, and a small window makes it easy to see how many coins are ahead within the switch. In excess of 100 coins can be held by the switch.

The standard time interval is 24 hours, calling for one 25-cent piece a day, but intervals of 6, 8, 12, 15, 20, 30, 40 and 48 hours are available. The change from one interval to another is made easily, by inserting different gears.

In addition to its application with electric refrigerators, where part payments on installations are collected by the coin boxes, the switch can be used in similar installations of other equipment, and also for the rental of washing machines and other devices in apartment houses.



Time switch operated by a coin

Soft Teeth and Cereals

THE results of research conducted for the (British) Medical Research Council by Dr. Mellanby, and published by His Majesty's Stationery Office, London, suggest that if cereals are to be fed to infants, plenty of Vitamin D must also be fed. An abstract of Dr. Mellanby's Special Report No. 191, Diet and Teeth, contained in *Nature* (London) states that: "the main

(*Please turn to page* 159)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

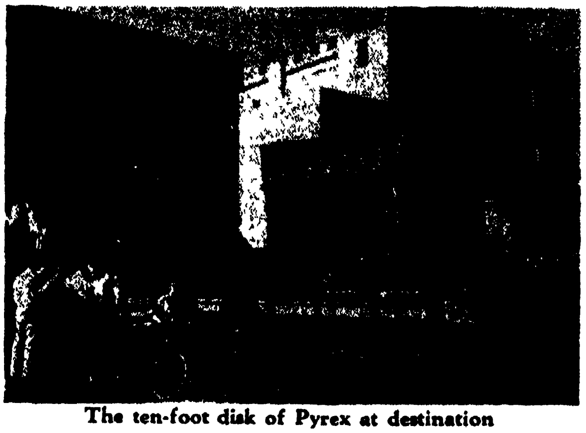
THIS month we publish several shorter items which have accumulated.

The first concerns a telescope made by a Benedictine nun, Sister Cornelia of Mount Saint Mary's Convent in Pittsburgh, whose photograph, kindly sent us at our request by her mentor in telescope making, Leo J. Scanlon of that city, is reproduced above. Sister Cornelia is an instructor in mathematics and physics at the high school in the Convent. "Before the bell sounds at 4:30 in the morning, summoning the nuns to chapel," says the Pittsburgh Press, whose photographer took this photograph, "Sister Cornelia trains her lens from her window to see Venus." The amateur telescope makers of Pittsburgh have elected Sister Cornelia an honorary member of their organization.

Sister Cornelia and her telescope

THE second picture shows the 120-inch Pyrex disk arriving at the optical shop of the California Institute of Technology. This disk is being figured as a flat for testing the 200-inch disk. The larger 200-inch disk cast last March at Corning was pre-cooled rapidly from 1800 to 120 degrees Fahrenheit, to permit an examination, which showed it to be crystal clear, free from cracks and bubbles. Whether the same disk will be repaired, annealed and used, or a new one cast has not been decided at present writing (July 20), newspaper reports to the contrary notwithstanding. The 200-inch mirror is to be aluminized, not silvered, and no doubt, when the time comes, that job will devolve on Dr. John Strong of the California Institute of Technology, the man who has mainly developed this process. In the meantime Dr. Strong keeps his hand in by aluminizing various smaller mirrors, from the 30-inch Crossley reflector at Lick to a three-inch mirror he gave to your scribe. A snapshot of Dr. Strong, taken by the same humble scribe, is reproduced on this page. An eight-page article by Dr. Strong, on evaporated aluminum mirrors, appeared in the February 1934 number of the *Publications of the Astronomical Society of the Pacific*. This article gives the best data thus far made available on this work.

SIX or eight years ago a very young lad named Evans besought our aid in building a telescope, and now his endeavors have finally led him to choose astronomy as a profession. Accordingly he has specialized in that science when in college, and has become just what he set out to be. Mr. Evans (see photograph, opposite page) did his undergraduate work at Swarthmore and has been an observer in the Flower Observatory of the University of Pennsylvania and a graduate student in astronomy for the past year or so. Next year he is to be at the Oak Ridge Station of the Harvard Observatory, with his principal duty as assistant to Dr. W. A. Calder in photo-electric photometry with the 61-inch reflector. Here is one amateur telescope maker who has already lost his amateur status—gone professional. Dr. Calder is another victim of A.T.M. who switched over from physics after making a telescope.



The ten-foot disk of Pyrex at destination

A DRAWING on the opposite page shows the mounting for the new 32-inch reflector at the Provence station of the Paris Observatory, as described in the *Journal of the British Astronomical Association* (Vol. 44, No. 5) by A. F. Bennett, F.R.A.S., who points out that in this design all esthetic considerations have been subordinated to simplicity and absolute rigidity. The polar axis is set definitely out of center to diminish the unbalanced effect of the tube. The leverage of the tube around the axis is thus reduced, while at the same time the heaviest part of the axis serves as a large part of the counterweight. The mounting is a combined Newt-Cass, and the diagonal is oddly set in order to reflect the rays out at a 125-degree angle. The 32-inch mirror is only 3 inches thick and, but for the lever supports, its flexures, which figure out 50 times the allowable limit, would be bad. Other things being equal, the deformations of mirrors due to their own weight, Mr. Bennett points out, are in the ratio of the fourth power of the diameter divided by the square of the thickness. An interesting piece of engineering design.

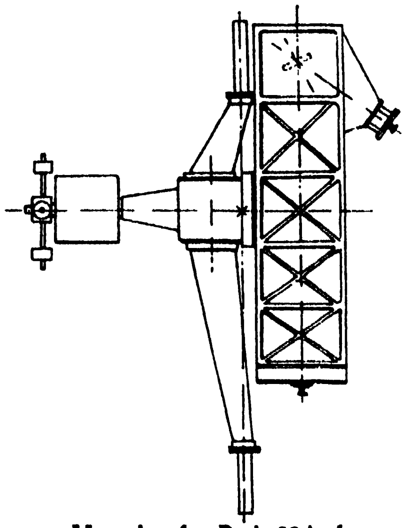
SOME workers take zone radius readings on mirrors by means of micrometers attached to the knife-edge, and express these in thousandths of an inch, which implies a high degree of accuracy. However, the question has arisen whether readings finer than hundredths of an inch do not represent fictitious accuracy. The worker may set the micrometer, and he may make the readings in thousandths of an inch, but can the eye estimate the opposite zones under comparison closely enough to justify these very precise readings? The ability of the eye to do this—its "contrast sensitivity" —varies with the amount of illumination (see, for example, Hardy and Perrin, "Principles of Optics," under "Fechner's fraction"); also with the distance of separation of the illuminated areas.

We submitted this question, with a sketch of the typical Foucault test set-up, to a noted physicist-illuminating engineer, and he answered as follows:

"You bring up the question of the photometric accuracy. This largely depends upon a perfect juxtaposition of the two brightnesses being compared. Under these conditions brightnesses can be compared to an accuracy of a fraction of a percent, providing a number of readings are averaged. However, ordinary photometric accuracy is commonly considered to be about 1 percent. Of course, as the brightness diminishes the accuracy decreases. As I understand your letter and drawing, the two fields are not perfectly juxtaposed but are perceptibly separated. This would diminish accuracy considerably. I do not believe I can estimate within

Dr. John Strong

a few percent the accuracy of a brightness comparison with the set-up you describe. However, I do not see how such comparisons of brightness could be accurate within several percent unless a very large number of readings were made and averaged. If your intensity of illumination is very low, I believe Fechner's constant would be of the



Mounting for Paris 32-inch

order of magnitude of 3 percent, even when the fields were perfectly juxtaposed.

"If I understand the set-up correctly, I would be inclined to estimate that, if you have very low brightnesses, the error of brightness match would be of the order of magnitude of 5 or 10 percent."

Perhaps it is not so bad as this. It would be interesting, however, if someone who understands the Foucault test would work out an answer to the question whether zonal readings expressed in thousandths of an inch mean something, or are largely illusory.

In the June number we mentioned that Richard Perkin, 122 Chester Avenue, Garden City, New York, would act as a sort of informal "committeeman" to ascertain how many would buy 20-inch mirror

Evans, who turned "pro"

disks of Pyrex, if such combined purchasing would result in a lowered price. Mr. Perkin received many inquiries and has now obtained a quotation on Pyrex disks, 20½ by 3¾ inches in size, in lots of six, of 85 dollars—a reduction of nearly one half from the ordinary price. By the way, Mr. Perkin is not a dealer, but an amateur who undertook to do this little job as a kindness. Evidently some thought him a dealer. He received a total of about 50 inquiries, to which the above is his answer.

RECENTLY PATENTED INVENTIONS

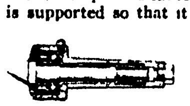
Conducted by A. P. PECK

BEACH CHAIR

Patent Number 1963708, Samuel W. Marvin. Folding chairs which are light in weight yet sturdy in construction are greatly to be desired for the beach and other vacation resorts, and several different forms are provided for by the present invention. One type is shown in the accompanying drawing wherein a back and seat portion are so arranged as to be adjustable to the position considered most comfortable by the user. Since the chair has only two short legs and has no other bulky supporting means, it is obvious that it can be folded into a very small space and can readily be set up for use when needed. In the particular form shown, the back is supported from the seat by means of straps; in other forms, wooden or other rigid members are used.

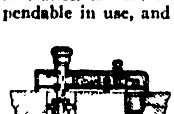
LATHE CENTER

Patent Number 1962499, Walter W. Gairing. The main object of this invention is to provide an improved lathe center in which the spindle is supported so that it will not chatter or vibrate, and so that it is capable of carrying heavy end and radial thrust loads. The center is also designed so that its structure is comparatively simple and only a few parts are used. As shown in the drawing, the spindle is provided with a reduced bearing part which is suitably mounted on combined radial and thrust bearings. A pair of these bearings is used, one being a ball-bearing unit and the other a roller-bearing unit. It is claimed that this particular lathe center is especially adapted for heavy work, and because of its sturdy and rigid construction can not be thrown out of adjustment by an unskilled workman.



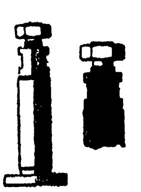
LOCK

Patent Number 1959361, John Holtzman. A new type of lock shown in the accompanying illustration is said to be simple and durable, dependable in use, and efficient in operation. Essentially, the lock consists of a casing which, when applied to a door, overlaps the jamb and has a bottom plate with openings so constituted as to receive and hold hooks attached to the door jamb. A bolt rotatably mounted has a pair of members which are designed to engage and hold the hooks and thus provide a secure locking arrangement. The lock is so constructed as to be operated by means of a key from one side or by turning a handle on the other, and is provided with a latch which holds it in non-operating position. The patent specification shows several different forms which this simple lock may take.



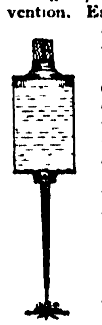
VALVE TAPPET

Patent Number 1957784, Charles E. Johnson. In automobile engines and other machinery where adjustable valve tappets are employed, one of the problems of maintenance is keeping the valves accurately adjusted. The subject of the present invention is a valve tappet which is self-locking. When these are used there is no necessity of first adjusting the tappet and then locking it in place by means of the conventional lock nut. Instead, the adjustable portion of the valve tappet is provided with a slot. By means of this slot the shank of the adjustable portion is somewhat expanded and this, together with proper threading of the adjustable part and the sleeve in which it fits, provides a locking arrangement which will withstand any ordinary operation. This complete valve tappet arrangement has only two parts. The outer sleeve is provided with a flattened portion which can be gripped with a wrench, and the inner or adjustable part has a head which can be gripped with another wrench. Holding the two parts in this manner, a proper adjustment can readily be obtained.



WEED GUN

Patent Number 1960738, Charles L. Giezentanner. A simple method of applying weed-killing liquids is provided by this particular invention. Essentially, the device consists of a container or reservoir, a valve controlled spout, and a handle. The drawing at the left shows the construction of the device. It is so designed that it can be produced cheaply, the container for the liquid being detachable from the spout and handle so that it can be thrown away when empty and replaced by a full one. A rod, which has at one end a valve, is located in the spout, the other end of the rod projecting beyond the spout. When the outer end of this rod is pressed into the center of a weed, the valve is actuated, allowing a portion of the liquid in the reservoir to run down and enter the puncture which has been made in the weed by the rod. When the device is lifted, a spring presses the rod outward and closes the valve, thereby shutting off the flow of liquid. When this device is equipped with a long handle, it is possible for the user to kill weeds rapidly and effectively without bending over. Pressure on the upper end of the handle accomplishes the job efficiently when any one of several well-known types of weed-killing liquids is placed in the container.



ELECTRIC SAFETY PLUG

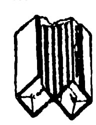
Patent Number 1956018, Charles E. Gilbert. One of the objects of this invention is to produce an electric plug of cheap and rugged construction to which insulated electric wires may be easily and quickly connected without removal of the insulation, and which will hold such wires with great tenacity and less danger of rupture than is obtained with conventional plugs. The connection between the wires and the prongs of the plug is obtained by providing serrated jaws into which the wiring is slipped. When these jaws are pressed together they puncture the insulation and make a firm electrical and mechanical contact with the interior wire.

EXTENSION FLASH LIGHT

Patent Number 1959979, George G. Gunderson. An improved flash light having a removable head carrying a lamp which may be operated as an extension lamp is provided by this invention. As shown in the accompanying drawing, a standard type of flash light is so adapted that there is a space above the battery in which is stored a flexible cable connecting the battery to the flash light bulb. The part of the device which carries the bulb is also so arranged, with a clip or other device, that when it is removed from the flash light case it can be hung up or otherwise supported in any desired position. Means are also provided for enabling the lamp to be attached to the head of the user while the case containing the battery may be carried in the pocket. In one form of the invention disclosed in the patent specification, the lamp housing is provided with a spring clip and also a vacuum cup which makes it possible to attach the extended lamp to any smooth surface.

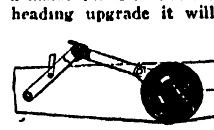
CIGARETTE CONTAINER

Patent Number 1960468, Eugene C. Wamelink. Cigarettes, when packed by the manufacturer for sale, are customarily wrapped and sealed in a moisture-proof package to preserve the freshness and flavor of the cigarettes. When such packages are opened by the user the wrapping is broken and partially destroyed. It is one of the objects of the present invention to provide means for cutting or tearing partly through an original package of cigarettes so that the package may be opened at the cut point by folding the other side, thus giving access to the cigarettes within. Another object is to provide a carrier or container for a package of cigarettes, in which is placed the package which has been cut partly through, as described. This container is provided with a hinged back so that when open cigarettes are exposed for ready removal.



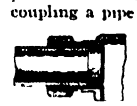
REVERSE LOCK

Patent Number 1957428, Ivo George Brennemann. One of the annoying features of driving a motor car is that if the vehicle is stopped when heading upgrade it will coast backward unless held by the brakes. The present invention provides for a mechanism which will prevent backing up under all ordinary conditions but will permit the operator intentionally to reverse the car when he so desires. The mechanical construction of this reverse lock is such that it will not in any way prevent the driving shaft of the vehicle from rotating when the car is driven in a forward direction. The result is achieved by mounting frictional rollers within a specially shaped housing in such a manner that the rollers will constitute an efficient and automatic frictional grip for locking the drive shaft against reverse rotation. Several modified forms of the invention are shown in the patent specification, one of them being reproduced herewith.



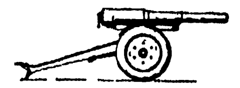
THREADLESS PIPE COUPLING

Patent Number 1959607, Ernst G. K. Anderson. The object of the present invention is to provide a simple and novel construction for coupling a pipe to a surrounding tubular element which may or may not be a part of a connection box. By the means shown in the accompanying drawing, a secure mechanical connection is obtained and the joint between the pipe and the tubular element is effectively sealed. The object is attained by providing a coupling nut to be screwed on to the tubular element and to embrace the pipe. Placed over the pipe and between the coupling and the tubular element is a suitably shaped fillet which, when the nut is tightened, is compressed and thereby forced into place to form a tight seal.



GUN CARRIAGE

Patent Number 1959357, Elmer C. Goebert. In wheeled gun carriages it is a common expedient to emplace the carriage for firing by substituting a fixed support for the wheels. The purpose of the present invention, illustrated in the drawing, is to provide a firing support which is associated in a novel manner with the wheels and the brake mechanism for the wheels. Mounted on the axles of the gun carriage are segments which, being longer than the radius of the wheels, can be lowered so as to raise the wheels off the ground, and when locked in position provide a rigid mounting for the gun. In emplacing the carriage for firing, the segments are unlatched and allowed to fall to the ground behind the wheels. The rear end of the carriage is then raised, the segments are locked to the brake drum, and when the rear end of the carriage is lowered to the ground the arc shaped segments will rotate into the proper position for firing.



THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 155)

conditions responsible for immunity from dental decay are prolonged breast-feeding with a supplementary diet often for three or even six years and a high intake of vitamin D (or exposure of the body to the sun) together with a sufficiency of calcium and phosphorus. A high carbohydrate diet (cereals or potatoes) is compatible with good teeth, provided the supply of vitamin D, calcium, and phosphorus is also sufficiently great. Caries is especially rampant where cereals form a large part of the diet; breast-feeding is short; the intake of milk, eggs, and animal fats is small; and sunshine is negligible or rendered ineffective by clothing.

"It has thus been shown that perfectly calcified and regularly arranged teeth can be produced by including in the maternal diet during pregnancy and lactation, and in the diet of the offspring at the time of dental development, substances containing much vitamin D, calcium and phosphorus, such as milk, eggs, fish and animal fats, and that cereals, especially those rich in embryo such as oatmeal, tend to produce hypolastic teeth and call for a correspondingly larger supply of calcifying foods for good development.

"It has further been established that the resistance to caries can be increased independently of the original structure by giving a diet containing much vitamin D, calcium and phosphorus, or decreased by a diet rich in cereals.

"If these general principles of feeding were widely adopted, there is little doubt that dental caries (and also pyorrhœa, to which a deficient intake of vitamin A predisposes) will cease to be the scourge they are at the present time.

"It may finally be pointed out that none of these conclusions conflicts with the generally accepted idea that the *exciting* cause of caries is the growth of micro-organisms in the mouth: the novelty is the proof that the tooth can resist the onslaught of the microbes by the absorption and assimilation into the body tissues of certain specific dietary factors."

Fireflies Flashing in Unison

FOR some unknown reason, fireflies flash in unison, thousands of them, almost as if led by an "orchestra" leader. An instance of this kind is described by one of the readers of this magazine, Earl Porter, Route 1, Cortland, Ohio, who writes:

"Tall trees lined the bank of the river for a distance of about 200 yards. I was watching the fireflies flitting among the trees. Then something began which held my attention. The myriad points of light, flashing at random against the black shadow of trees, began to assume a sort of regularity. Though still evenly distributed among the trees, the flashes occurred simultaneously, at intervals of a few seconds, with a short period of almost total blackness between flashes. This seemed peculiar. Then the flashes occurred only at the extremities of a stretch about 200 yards long, in front of the trees. The flashes began moving

toward each other, met at the middle, and traveled back to the ends, as when two pebbles are dropped simultaneously into the ends of a long, narrow tank of water and the waves roll toward each other, meet and return, several times until the motion subsides. This movement was repeated a number of times. Then the lights concentrated at one end of the stretch, and moved swiftly toward the other end—down and back, twice—then all at random again. I was amazed, but there was no doubt about it having happened. Does natural history record such a phenomenon?"

Similar phenomena have been reported to science in many instances, and scientists, particularly Dr. E. W. Gudger of the American Museum of Natural History, have collected and published many of these instances. There is no dearth of similar observations but a dearth of really plausible interpretations—that is, not guesses, but actual data. Probably nobody knows why fireflies flash in synchronism.

Football Bladder Keeps Paralyzed Man Breathing

A FOOTBALL bladder strapped to his chest has kept an almost completely paralyzed patient, S. Crosby Halahan, breathing continuously for months, it appears from a report by Dr. Phyllis Tookey Kerridge of the London School of Hygiene to the current issue of *The Lancet*, medical journal published in London. Dr. Tookey Kerridge has just designed a new apparatus to replace the football bladder.

Mr. Halahan is a man now 63 years old. He is suffering from a progressive wasting of the muscles which started in 1927. Although almost completely paralyzed he is still mentally alert and contented. By 1931 he began to have difficulty in breathing, as a result of the gradual paralysis of his muscles.

From June, 1932, until September, 1933, he was kept alive by manual artificial respiration maintained continuously by relays of relatives and nurses. Then his friend, Sir William Bragg, Fellow of the Royal Society, designed a hand-operated machine for inflating a football bladder bandaged to Mr. Halahan's chest. In October, 1933, he designed hydraulic bellows for inflating the football bladder, which have worked successfully ever since, except once when the water froze.

An old injury to the right side of Mr. Halahan's chest has made it extremely sensitive to pressure, so Dr. Tookey Kerridge designed a rubber bag which surrounds the left side of his chest only, and is now successfully taking the place of the football bladder apparatus.—*Science Service.*

Ethylene Gas Loosens Walnut Husks

CHEMISTRY has solved many a problem that was considered a "tough nut to crack" but it is only recently that chemists of the U. S. Department of Agriculture have discovered that ethylene gas will literally coax walnuts from their husks. This ethylene gas is the same that is used by orange growers to speed up the ripening of green fruit.

In the commercial harvesting of walnuts, the trees are shaken as soon as the outer husk of the nut begins to crack. On from 15 to 50 percent of the nuts the outer husk has not yet cracked. Those which have commenced to split can be husked in the field, washed, and taken to dehydrators. Those which have not split, and which are termed "stick-tights," must be subjected to a rather lengthy treatment, entailing additional expense and staining some of the shells, so that the nuts must be sold as culls.

The ethylene gas treatment has apparently solved the problem of "stick-tight" nuts. On account of the ease with which the new method can be applied, together with its low cost, estimated at six to eight cents a ton, and the higher grade of nuts so treated, leading walnut growers believe that a revolutionary change in walnut harvesting is at hand. However, nuts so treated will not be placed on the market until storage tests indicate that no adverse effect of any kind has been produced.—*A. E. B.*

"Doping" of Race Horses Detected by Mouse's Tail

A TEN-MINUTE test with a mouse will show whether or not a horse has been "doped" with morphine or heroin before a race, Dr. James C. Munch of Temple University and the Sharp and Dohme research laboratories has reported to the American Pharmaceutical Association.

A quarter of a teaspoonful of the horse's saliva is injected into the mouse. Within 10 minutes the mouse's tail curves up into a letter S, if the horse has been given morphine or heroin. In addition, the mouse humps up his back, his hair stands on end and his hindlegs become twittery. Other substances produce this effect on the mouse's tail, but the combination of tail curve and the other symptoms described are produced only by morphine, heroin, or other opiate, Dr. Munch said. He was the first person to work out these details and to apply them to the problem of detecting "doping" of race horses.—*Science Service.*

Solid Alcohol

SOLID alcohol, for use as a fuel, is made by combining ethyl alcohol with nitrocellulose (gun-cotton) in a manner that utilizes the fact that *cold* alcohol dissolves nitrocellulose better than warm. According to a recent patent, outlined in *Chemical Industries*, the nitrocellulose, insoluble in the absolute alcohol at ordinary temperatures, becomes soluble when the alcohol is chilled to low temperatures. In this process a mixture of nitrocellulose and absolute alcohol is chilled to approximately -20 degrees, Centigrade, and a similar amount of aqueous alcohol, chilled to approximately the same temperature, is added. The mixture solidifies when allowed to warm to atmospheric temperature.—*A. E. B.*

Milk is Source of Common Salt

ALTHOUGH milk is generally recognized as the best dietary source of the essential minerals, calcium and phosphorus, few persons realize that it is also an excellent source of sodium and chlorine which, together, comprise the necessary food substance known as common salt. A quart of milk contains the equivalent in sodium and

chlorine ions of three grams of salt, or slightly more than the minimum daily needs of the human body.

As pointed out by Dr. James A. Tobey in the *Milk Plant Monthly*, the function of common salt in the human body is to aid in maintaining an equilibrium of the bodily fluids, such as the blood, lymph, and gastric juice, and it also assists in the retention of water in the muscles and other tissues. According to Dr. Tobey, the liberal consumption of milk will not only provide the various important nutrients of this almost perfect food, but the consumer will be assured of an adequate amount of common salt in the diet, without danger from an excess if he also employs salt as a condiment and flavor for other foods.

Music by Telegraph

EACH night for the duration of the World's Fair in Chicago, a musician seats himself before a telegraph typewriter in a Western Union office in a different city in the United States, and plays the Deagan chimes in the tower of the Hall of Science on the Fair grounds. Hundreds or thousands of miles away from the chimes, the musician can still play them as easily as if he played the keyboard in Chicago.

Keyboard from which chimes may be played from a far distant point

To explain how this is possible, it is first necessary to describe the telegraph typewriter. Instead of transmitting dots and dashes, the modern telegraph typewriter transmits evenly timed electrical impulses during one or more of the five successive time intervals necessary to transmit the various combinations for each of the various characters used on the typewriter.

For example, if an electrical impulse is sent during the first time interval and none during the four successive intervals, this signal will select from the 32 keys of the telegraph typewriter the letter "E" and cause it to be printed on the typewriter platen. If the electrical impulse is sent during both the first and second time intervals the letter "A" will be selected and printed, and as a third example, if the first, third, and fifth intervals carry the current, the letter "Y" is produced. Thirty-two different selections may be made in this manner. It is possible to select the 26 letters of the alphabet and to shift to the upper case for the selection of figures and for the various mechanical functions required of the telegraph typewriter.

The same selecting device which operates the typewriter may be adapted to any other function requiring the use of 32 selections, and in this case the machine has been connected to the carillon at A Century of Progress. This instrument, however, has only 25 chimes and, therefore, requires only part of the total number of keys.

In order to make it easier for any musician to play the Telemusicon, as the selecting device is known, a small two-octave piano keyboard is attached to the telegraph typewriter, mechanical connections being made from the piano keys to the typewriter keys immediately above them. Some of the foremost chimers and musicians participate in the nightly programs of the cities taking part and their playing, transmitted by telegraph, is heard by the assembled thousands in Chicago.

Ancestor Seeds 325 Million Years Old

MORE evidence that some 325,000,000 years ago there existed a "missing link" in the plant world, a common ancestor type of plant from which both the modern seed bearing plants and the seedless plants evolved, was reported by Dr. C. A. Arnold, curator of fossil plants in the University of Michigan Museum of Paleontology, upon identification of several seeds found last summer in Pennsylvania.

Seeds as old as those found by Dr. Arnold have been discovered only twice before—once in the Catskill Mountains and once in Ireland. Dr. Arnold made his find in northern Pennsylvania rocks dating from the Devonian period, at least 325,000,000 years ago, and about 30,000,000 years before the Carboniferous period, when the great coal beds were deposited.

As in the case of the Catskill and Irish seeds, plants having fern-like foliage were found in intimate association with the seeds. Presumably the seeds belonged to this plant. This strengthens the supposition that at some ancient time in the earth's history there was one common type of land plant from which the seedless ferns and the present-day type of seed-bearing plants branched off, says Dr. Arnold.

The Country Is "Shining Up"

THE depression must be over, for America has begun to shine up the old "bus" and to polish the hardwood floors again, according to current statistics. Heavy imports of animal and vegetable waxes since the beginning of 1934 reflect increased activity in domestic production of polishes. During the first four months of the current year imports of such raw materials totalled 6,750,000 pounds valued at 1,150,000 dollars, compared with 3,872,000 pounds valued at 409,750 dollars for the corresponding period of 1933.

The bulk of wax imports consists of carnauba wax from Brazil, receipts for which amounted to 4,581,000 pounds valued at 794,300 dollars during the first four months of the year—more than double the amount imported during the corresponding period of 1933. Other wax imports include beeswax, chiefly crude unbleached, Japan wax, Chinese insect wax, and various vegetable waxes.—*A. E. B.*

CURRENT BULLETIN BRIEFS

Short Cuts to Power Transmission, is a 72-page booklet for belt users and contains all information needed in solving any ordinary belt transmission problems, as well as valuable material on good practice, and a mass of associated tables and data. *Write for Bulletin 9D to Scientific American, 24 West 40th Street, New York City.—Gratis.*

A Review of Railway Operations in 1933. (Reprinted from *Railway Age*, Special Series No. 62.) This study of railway operations is by Dr. Julius H. Parmelee, Director, Bureau of Railway Economics, and no one is better fitted than Dr. Parmelee to describe the upward trend of railway business in 1933. *Bureau of Railway Economics, Washington, D. C.—Gratis.*

Manual of Welding and Fabricating Procedures for "Incaclad" Stainless Clad Steel is a 16-page booklet which takes up step by step the various methods of welding, soldering, lock seaming, riveting, deep drawing, pickling, heat treating, and so on, encountered in fabricating products of stainless clad steel. *Write for Bulletin 9C to Scientific American, 24 West 40th Street, New York City.—Gratis.*

The Post-War Development of International Law and Some Contributions by the United States of America—Troubles of a Neutral—Soviet Foreign Policy. (International Conciliation. June, 1934. No. 301.) The first author, Dr. Manley O. Hudson, describes the progress made in international law since the World War. The second article is by Charles Warren, who was charged with enforcing our neutrality laws; the third, by Michael T. Florinsky, describes the foreign policies of the Soviet Union during the past ten years. *Carnegie Endowment for International Peace, 45 Portland Street, Worcester, Mass.—five cents.*

Lubrication of Grain Handling Machinery. Strange to say there is little literature on grain-handling machinery. The problems involved are not only lubrication but concern dust explosions which are very prevalent and destructive. This pamphlet gives an excellent idea of both the hazards and the proper forms of lubrication. *Write for Bulletin 9A, Scientific American, 24 West 40th Street, New York City.—Gratis.*

On the Practical Impossibility of a Commodity Dollar, is a study by Benjamin M. Anderson, Jr., Ph.D., Economist of The Chase National Bank, New York, and gives an analysis of the main types of proposals for stabilizing commodity prices by currency manipulation. *Chase National Bank, New York City.—Gratis.*

Brown Resistance Thermometers. This pamphlet deals with measuring devices for temperatures from −300 degrees to +1000 degrees, Fahrenheit. The principle involved in these resistance thermometers concerns the property which most electrical

conductors possess of changing their electrical resistance with variations in temperature. The pamphlet gives information as to the various uses to which the instruments can be put. *Write for Bulletin 9B to Scientific American, 24 West 40th Street, New York City.—Gratis.*

A PLAN FOR UNIFICATION OF THE EASTERN RAILROADS—ITS RELATION TO RAILROAD RECOVERY, by A. J. County, Vice-President in charge of Finance and Corporate Relations of the Pennsylvania Railroad Company. The pamphlet shows how a united eastern railroad system would eliminate wasteful competition and tells how England has faced and dealt with almost identically the same situation. *The Wharton Alumni Institute of Business, University of Pennsylvania, Philadelphia.—Gratis.*

BLASTING DITCHES WITH EXPLOSIVES. A blasted ditch may be described as a series of overlapping craters each made by the explosion of an individual charge of dynamite, but so arranged that all the charges explode at the same time. The pamphlet describes the technique in detail. *Write for Bulletin 9E to Scientific American, 24 West 40th Street, New York City.—Gratis.*

WHY THE BATTLESHIP?

(*Continued from page* 142)

the accepted belief among naval authorities that the battleship is the only type that is not extremely vulnerable to the many forms of attack to which surface craft may be subjected. It must be borne in mind that the development of the battleship has been progressive, and consummate skill has been shown by the designers in effectively weeding out any offensive weapon. The submarine and mine have developed the intricate compartmentation in a battleship that make her practically unsinkable. The advent of aerial bombs has brought about the development of the blister and protective decks to the point that they will successfully resist high-powered bombs. Effective means have been taken to protect the personnel from gas attacks. However, these changes in design have necessitated added weight, and added weight means greater displacement. To give adequate protection with less displacement would be at a sacrifice of offensive power, armament, and cruising radius—all vital characteristics of a battleship.

Practical experimentation has been made on the new and old types of ships and on specially constructed sections of hulls to show the effect of high explosives. Torpedoes, mines, explosive shells, and bombs have all been used in this connection. From data derived from these tests the constructor has designed special features in hull construction and compartmentation to resist the actions of high explosives.

Special steel decks have been designed that will explode bombs before penetration, thus localizing damage and protecting the vitals of a ship.

The British, during the World War, took the lead in the design of blisters which provided excellent underwater protection. The blister has been developed by the naval

architect in two forms: either an external protuberance, or an internal arrangement, both of which provide a multiplicity of tough, parallel, longitudinal, elastic bulkheads, between which, at short intervals, are short transverse bulkheads, all forming a honeycomb of compartments. Some of these parallel layers of compartments could carry oil or some other energy-absorbing medium, while others are merely void. The energy of the gases from an explosive is gradually absorbed by having to rupture the bulkheads and pass through the liquid, so that the inner bulkheads would remain intact and protect the vitals of the ship inboard. By intricate draining and flooding of these compartments, damage control may be exercised and a wounded ship maintained on an even keel, so that efficiency of gun fire is not impaired.

The more modern ships are built along these lines and the older types have been modernized by extensive reconstruction.

Gunnery has likewise made extensive strides since the World War and the anti-airplane batteries have been developed to a high degree. It is believed that the anti-aircraft batteries of the battle line could give a fine account of themselves in an air raid and further development is expected in the future.

While it is desirable to keep down size and cost of battleships and to limit their length in order to retain their maneuverability, the history of their development indicates that they have been forced to increase in size to provide guns and armor adequate against similar ships, to provide torpedo protection, and to provide sufficient deck thicknesses for modern gun ranges and aerial attack. In common with other types of fighting craft, also, battleships have had to devote much weight and displacement to efficient compartmentation.

Whether it is possible to obtain on the Washington Treaty limit all the offensive and defensive qualities desired from considerations of the power of modern guns, torpedoes, and bombs on the one hand, and the resistance of armor and bulkheads on the other, is a difficult problem, the successful solution of which will demand the application of the most modern developments of the shipbuilding art. Limitation of displacement, however, will sacrifice much that we now have and in addition give little leeway for those future developments which we have every reason to expect.

Of all combatant ships the battleship is the only one designed to stay and "take it." Nothing else is tough enough because nothing else has sufficient size. That is the main and outstanding reason why battleships are necessary in our first line of defense.

Our Navy will be strong offensively and defensively in direct proportion to the strength of our battle line, made up of capital ships. There is little difference between the tactics of a well handled fleet and of a well run football team. The same axioms apply in general. Neither can be successful without a strong and well trained line.

The Navy believes that if the practical demonstration—a war—ever comes, the battleship will prove its worth in every respect. In the meantime the case of the battleship is submitted and may be rested with much confidence on the following points:

1. The big gun ship is the hardest hitting and best protected type of vessel yet designed.
2. Ability to give and take punishment.
3. Tactical value in all weather, sea conditions, and for long periods of time.
4. Can best embody all weapons of sea offense and defense.
5. Affords better protection from air attacks than any other surface type.
6. The last word in ships and sustains the other types.
7. Most reliable defense against blockade and invasion from overseas.
8. The ship upon which will depend the final decision at sea.

When the torpedo has acquired the range and precision of a 16-inch gun, when a lighter ship is designed to give and take on equal terms, when the radius and carrying power of aircraft have increased tenfold, when aerial bombs are as accurate and effective as 16-inch high explosive shell, and other types are effective under all conditions of wind, fog, and sea, then, but not until then, will the supremacy of the battleship be endangered.

STARS ON PARALLEL TRACKS

(*Continued from page* 133)

should ultimately be disintegrated—provided, of course, that the general dimensions of the galaxy and the material universe remained the same during this enormously long time.

The principal interest of such calculations lies, however, not in the future but in the past. We find in the heavens clusters like the Pleiades, which have a life of ten billion or twenty billion years before them; others, like the Hyades, with only two billion or three billion years; while the Ursa Major group, and Kapteyn's enormous and widely scattered southern stream, appear to be already well on the way to disintegration.

If the universe of stars in anything like its present state had existed for hundreds of billions of years in the past, it would be very surprising that all star clusters had not already disintegrated. Bok's more detailed analysis shows that their actual presence in the galaxy indicates that this greater star system has not existed under conditions similar to the present for so much as twenty billions of years, and may have had a considerably shorter life.

This whole discussion is quite independent of the theory of the expanding universe, but supports strongly its most interesting conclusions—namely, that we can set definite limits to the age of our universe. Starting with ordinary unalterable space, and the simple Newtonian law of gravitation, it shows that scattered groups of stars with common motion cannot last forever. The maximum age which it gives is greater than that set either by the motions of the nebulae or by radioactive processes in the earth; but this is as it should be, since the first is a true upper limit and may be considerably too high, while the others have a smaller margin of doubt. The evidence, however, in favor of the "short" cosmical time scale of billions of years, rather than the "long" scale running into trillions, is apparently very strong.

Books SELECTED BY THE EDITORS

LEARNING TO SAIL

By H. A. Calahan

LEARNING TO RACE

By the same author

HERE are two books that will interest every landlubber who has ever had a hankering to sail, and every sailing craft owner or skipper whether he has sailed for a week or a generation. "Learning to Sail" was first published two years ago and is now available in a new edition which includes much valuable information not found in the original. The author has a knack of imparting his knowledge, gained through 35 years of sailing, so that the novice can soak it up and retain it. Throughout these two books explanatory phrases prevent confusion where terms unfamiliar to the layman are used. "Learning to Race" is written especially for those who have mastered the art of sailing small craft under ordinary conditions and who want to become familiar with racing technique, rules, and so on. Diagrams and photographs make everything clear as a bell. If you sail a small craft, you will want both of these books; if you have never sailed, but read these books, you won't rest easily until you get your hands on a tiller with a fair breeze speeding you along. Perusal of both of these books will add greatly to your enjoyment in following the press reports of the coming America's Cup Races, or in watching the races themselves. "Learning to Sail," $2.65 postpaid. "Learning to Race," $3.65 postpaid.—*A. P. P.*

HOW TO COLLECT MINERALS

By Peter Zodac

IN this 80-page book the editor of the mineral collectors' magazine, *Rocks and Minerals*, gives full and explicit instructions for starting a collection of minerals: How to begin; hints on collecting; what to collect (gems, geological specimens, fossils); collecting in the field; equipment; where to look for minerals; preparing the specimens; organizing a mineral collectors' club; and many other immediately practical aspects of the mineral hobby which has become quite widespread and popular within recent years. A list of books on mineralogy, gems, geology, and prospecting is included. When you have this book you can go right ahead with your hobby, since it gives definite details instead of vague generalities, as too many books do. Mineral collecting provides a fine introduction to earth science, to the great outdoors, and to some fine fun. It will work off some of your waist line. —$1.10 postpaid.—*A. G. I.*

THE SCIENCE OF WORK

By Morris S. Viteles

THE study and treatment of problems of human adaptation to work in the Machine Age are the chief functions of industrial psychology. A shorter, simpler volume than the author's "Industrial Psychology," free from technical and statistical terminology, covering the same ground. It tells how psychology is applied in making work a happier and more productive activity. It is designed to promote a better understanding of the mental aspects of efficiency and adjustment in modern industry. The orientation of this volume is practical. It will be useful to all who deal with human nature in industry.—$3.95 postpaid.

OCEAN WAVES AND KINDRED GEOPHYSICAL PHENOMENA

By Vaughan Cornish, D. Sc.

THIS is a popular and most readable special study of waves—mainly ocean waves—their height, length, velocity—but also waves in sand dunes and on the bottoms of bathing beaches and in drifted snow. It tells how to measure accurately the height of waves from the deck of a ship, and so much else of interest about waves that few of us have ever heard of, that its reader will possess a whole new science having an everlasting incidental interest. It also contains a more technical section about the physics of waves, by the noted geophysicist Harold Jeffreys. Dr. Jeffreys states that Dr. Cornish has obtained a larger quantity of observational material than any other worker on the subject.—$3.95 postpaid.—*A. G. I.*

THE NEW TYPOGRAPHY AND MODERN LAYOUTS

By Frederic Ehrlich

A COMPREHENSIVE reference book for students of typography and layout, which, as the author points out, is designed to accomplish two purposes: First, clarify the confusion, doubt, and uncertainty that exist regarding the precepts and history of the new typography in European countries and its inception in America, and second, to acquaint the reader with the basic balances that have resulted from the first efforts and experimentations of a group of foreign typographers and the effects of these on American typography. A beautiful book, 9½ by 12½ inches, with over 1000 specimen layouts for study by compositors, typographers, and layout men in advertising agencies, print shops, and classroom. $5.25 postpaid.—*A. P. P.*

THE BIRD KINGDOM

THIS book consists of 20 large plates, each showing several kinds of birds in three dimensions. This is made possible by the familiar device of printing slightly offset red and green pictures, and viewing them through celluloid "spectacles of red and green" (furnished with the book). The subjects are elaborate exhibition groups at the Field Museum of Natural History in Chicago. The different birds shown are keyed and identified.—$2.15 postpaid.—*A. G. I.*

OUTLINE OF CLINICAL PSYCHOANALYSIS

By Otto Fenichel, M.D.

THIS is a presentation of clinical data which psychoanalysis has collected in the course of its almost 40 years, and it presupposes some previous elementary knowledge of psychoanalysis. The language partakes of the elusive nature which is characteristic of most works on psychology, compounded in this case with the fact that the book is a translation from that ponderous tongue, the German. Hence this book is recommended mainly to heroes and gluttons for punishment, or to masochists. The translators themselves state that its author frankly sacrifices simplified clarity to systematic completeness and here they show real insight.—$5.20 postpaid. —*A. G. I.*

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COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Triplex Patent Valid and Infringed

IN a recent patent infringement suit brought by the Triplex Safety Glass Company of North America against the Duplate Corporation, the District Court of Pennsylvania held the Benedictus patent number 1182739 to be valid and infringed. This patent pertains to non-shatterable glass, a product made by both companies, the plaintiff operating under the patent.

The following is quoted from the findings of the District Court:

"This is a patent suit involving Benedictus patent, No. 1182739, issued May 9. 1916.

"Claim 12 in that patent is in suit:

"'12. As a new article of manufacture. a sheet of celluloid faced on both sides and in the order named by sheets of gelatin and glass, all rigidly and autogeneously united together, and the gelatin being substantially free from contained moisture, as described.'

"The patent relates to nonshatterable glass. In the prior art the strengthening of glass by inserting a sheet of celluloid between the sheets of glass was known, and the use of balsam for causing the sheets of glass and celluloid to adhere together was disclosed in the prior patent of Wood. The fact that gelatin might be used as an adhesive was also known to the prior art.

"The plaintiff contends that Benedictus brought to the art the use of gelatin substantially free from contained moisture as an adhesive element in causing the sheets of celluloid and glass to adhere together. . . .

"We have no hesitation in concluding that the patent is valid; that there was a real invention in bringing to the art the product made by adhesion of celluloid and glass with the use of gelatin that is substantially free from contained moisture. It was thoroughly demonstrated that using wet gelatin or sticky gelatin for the purpose of cementing together the sheets of glass and celluloid resulted in a product which was streaked and cloudy. . . .

"We need next to determine whether or not the defendant by its product has infringed the patent. We find from the evidence that the defendant in its product uses glass and celluloid cemented together by a thin film of gelatin in substantially the same manner as that disclosed by the Benedictus patent. . . .

". . . the main element is there—gelatin with the moisture sufficiently extracted so as to cause the sheets of celluloid and glass to adhere to one another with no impairment of transparency. That is the product of both processes used by the plaintiff and the defendant. . . .

"We therefore find on the whole case that the patent in suit is valid and has been infringed. . . ."

The decree of the District Court was affirmed by the Circuit Court of Appeals, Third Circuit, and the defendant has been ordered to pay over half a million dollars in damages and claims to the plaintiff.

Radio Advertising Censored

RADIO advertising is to be subjected to the scrutiny of the Federal Trade Commission, according to an announcement made by that Commission recently. This announcement means simply that the Federal Government will extend to radio advertising the same principle that for many years has been applied to newspaper, periodical, and other forms of advertising, under Section 5 of the Federal Trade Commission Act, which gives the Commission jurisdiction over unfair methods of competition in interstate commerce. This the courts have uniformly held to embrace false and misleading advertising. The Federal Trade Commission has handled thousands of such cases.

Anticipating complete harmony with the radio industry, as already manifested by some of the leading executives, the Commission is approaching the radio field in a spirit of friendly co-operation. Consequently, instead of adopting a plan of monitoring broadcasting programs, the Commission is asking for copies of advertising announcements to be furnished by the networks and broadcasting stations. Pursuant to that plan, the Commission has addressed letters to the broadcasting stations requesting them to mail weekly copy of commercial continuities, which will be checked to determine whether or not any of them are in violation of the Federal Trade Commission Act.

Whenever statements occur in commercial announcements which appear to be false and misleading, or otherwise constitute an unfair method of competition in commerce, notices will be sent both to the advertiser and the radio station broadcasting the advertising, with the view of effecting a stipulation under which the advertiser and the broadcaster agree to cease and desist from the practices complained of. Execution of such a stipulation would end the case. However, should such compliance not be effected, the case would then proceed through a public hearing, with argument before the Commission, decision by the Commission, and perhaps appeal to the Courts.

Beards on Trial

IN a recent case decided by Judge Woolsey in the District Court for the Southern District of New York, it was held that the cut of a man's beard was not susceptible to exclusive appropriation. The Israelite House of David, familiarly known as the House of David, brought suit to restrain unfair competition on the part of the defendant in the simulation of its baseball team. The defendant operated a bearded baseball team which wore uniforms bearing the words "House of David" across the front. Plaintiff further showed that defendant's team, posing as the "House of David" team, booked games a few days ahead of the date set for the plaintiff's team, thereby destroying in that neighborhood the interest in the plaintiff's team. The Court restrained the use by the defendant of the uniforms bearing the House of David inscription but refused to restrain the defendant from requiring his players to wear beards. In his opinion, Judge Woolsey stated:

"The plaintiff complains quite bitterly because the defendant's ball players are all required to wear beards like those of the plaintiff players.

"From time immemorial, however, beards have been in the public domain. In respect of matters within that domain all men have rights in common. Any man, therefore, if so minded, may—without being subject to any challenge, legal or equitable—not only grow such beard as he can, but purposely imitate another's facial shrubbery—even to the extent of following such topiary modification thereof as may have caught his fancy."

It follows that while the defendant's ball team may still maintain its beards as an added attraction, it may not hold itself out to be the House of David team or wear uniforms with that name appearing upon them.

"Ironized Yeast" Curbed

THE Federal Trade Commission recently announced it had ordered Ironized Yeast Company, of Atlanta, Georgia, to cease and desist from representing in newspaper, radio and other advertising that use of its product, "ironized yeast," can or will end or cause to vanish over night such ailments as indigestion, constipation or skin eruptions.

"There is no advantage in the combination of iron and yeast in one compound," the Commission reported in its findings, relying on expert opinion. "Such combination cannot and does not produce more effective or beneficial results than the administration of iron and yeast separately."

The respondent is directed to cease representing that indigestion, constipation, nervousness, and other diseases can and will be cured or relieved by use of this yeast, except when they result from or are produced by a deficiency of Vitamin B or of iron or both of them.

Also, it is not to be advertised "that skinny or scrawny persons or those deficient in shape or form can or will by use of Ironized Yeast develop well-rounded and curved limbs and otherwise become transformed into shapely persons, or that Ironized Yeast furnishes the means for attainment of beauty or attractiveness, except as far as the health of persons which has been impaired by deficiencies in Vitamin B or in iron or in both may be improved and appetite and weight gained, by the use of Ironized Yeast."

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NINETIETH YEAR • ORSON D. MUNN, Editor

NRA CODE

CONTENTS · OCTOBER · 1934

Cover

WHAT would an ancient Athenian have said if told that most of his city during a lapse of centuries would be buried beneath the rubbish and earth dragged in by his descendants and that after two thousand years an alien race would come to Athens from an unknown continent beyond the edge of the world and uncover it, in order to see how he lived and what he did? Our cover shows some of the excavations being carried on in Athens, and described on page 181. In the cover picture the Theseum is at the upper right and the circular floor of Tholos is toward the left.

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ACROSS THE EDITOR'S DESK

As promised on this page last month, we present in this issue one side of a controversial subject that affects every business man and industrialist throughout the country: Shall America be self-contained? Hon. James W. Gerard is firm in his conviction that it should and must. He gives his reasons for his relentless nationalist stand on page 194 of this issue. But, as we said before, there are two sides to every question, and we have arranged for an article by Raymond B. Fosdick which will tell the story of the other side. There is no doubt that the future of American industry rests, at least in large part, upon the policies adopted in our business dealings with foreign nations. These two articles, the second to be published soon, will give you the whole picture, and place facts in your hands which will enable you to form your own conclusions.

●

PROBABLY nowhere in the history of science can there be found a postulate that has caused so much dissension among the scientists themselves as that of the ether. "The idea of the possible existence of the ether came of the human need for an explanation of action at a distance," writes Churchill Eisenhart, of Princeton University, in an article entitled "The Ether: Riddle of the Ages," scheduled for early publication. Mr. Eisenhart deals with the vicissitudes of the ether theory during the swaddling days of science, putting forth clearly and briefly the various changes through which it has gone in order that science might adapt it to existing needs. Everyone who studied physics remembers the ether: Where is that old friend of the classroom, and what is its status in today's world of science? The answers will be found in Mr. Eisenhart's article.

●

"IT may never have occurred to the reader that it is possible for an amateur to cut and polish worth-while semi-precious gems. All that is needed is a fair degree of mechanical skill." Thus writes Arthur Knapp in an article on the making of faceted gems by the amateur lapidary. Former articles in SCIENTIFIC AMERICAN have introduced readers to the hobby of gem cutting in its more simple phases; here is advanced work that will prove both fascinating and satisfying. Even if you have no definite interest in the hobby for yourself, you will be interested in this article, to be published soon, and particularly in a photograph which accompanies it, showing a group of beautiful gems which Mr. Knapp has cut.

COMING

¶ Raymond B. Fosdick, on the dissenting side of the question "Shall America be self-contained?"

¶ "The Ether: Riddle of the Ages," by Churchill Eisenhart, Princeton University.

¶ "Faceted Gems for the Amateur Lapidary," by Arthur Knapp.

¶ Robert D. Speers on the siphons being built in the Colorado River Aqueduct.

¶ Nickel—the story of how the "devil metal" has become "near-noble."

¶ The 14-inch coast defense guns at the Panama Canal—a two-page drawing.

●

ARTICLES last month and in this issue have recorded progress of certain phases of the work being done at Boulder Dam and upon the aqueduct tunnels which will supply water to 13 communities in California. While the tunnels are under construction, other crews are working on huge siphons which will link together these underground bores. Robert D. Speers, who wrote the article on the tunnels in our September number, has prepared another on the construction of the siphons, which will be published next month. Aqueduct siphons are not siphons in the true sense of the word. Rather, they are . . . but Mr. Speers' article tells the story in detail; watch for it in November.

●

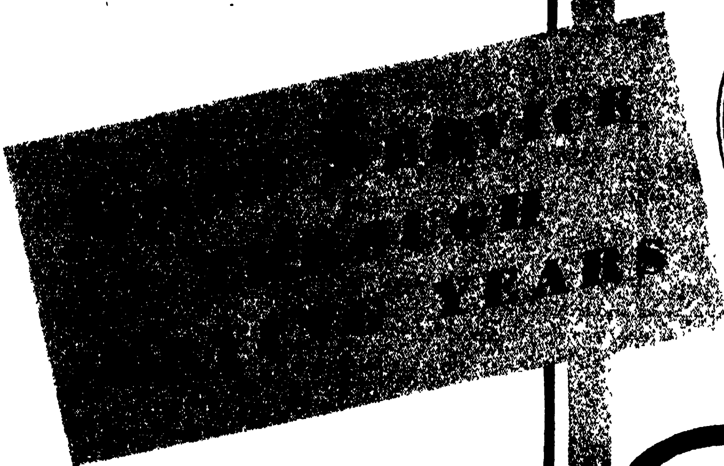
NICKEL, called the "devil metal" by early miners because of its frequent appearance in silver ore and its apparent uselessness, has, with the development of the science of alloying, assumed a position in metallurgy that entitles it to be called "near-noble." More or less of a curiosity 50 years ago, nickel production rose gradually until the World War, at which time the demand for it jumped tremendously, for use in armaments. Then production again fell off, but research went to work on the problem, with the result that today nickel is used for hundreds of purposes and its production is growing rapidly. The whole story of the nickel industry is told in an article ready for early publication.

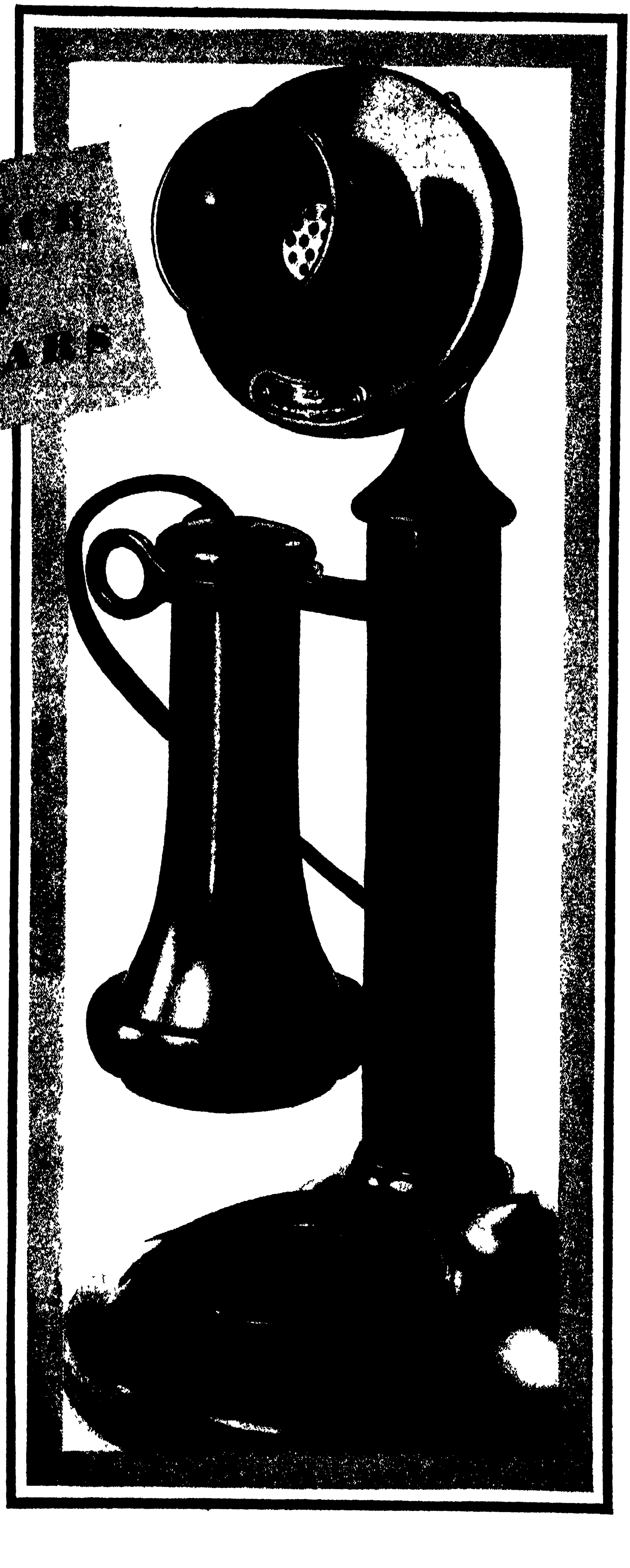
●

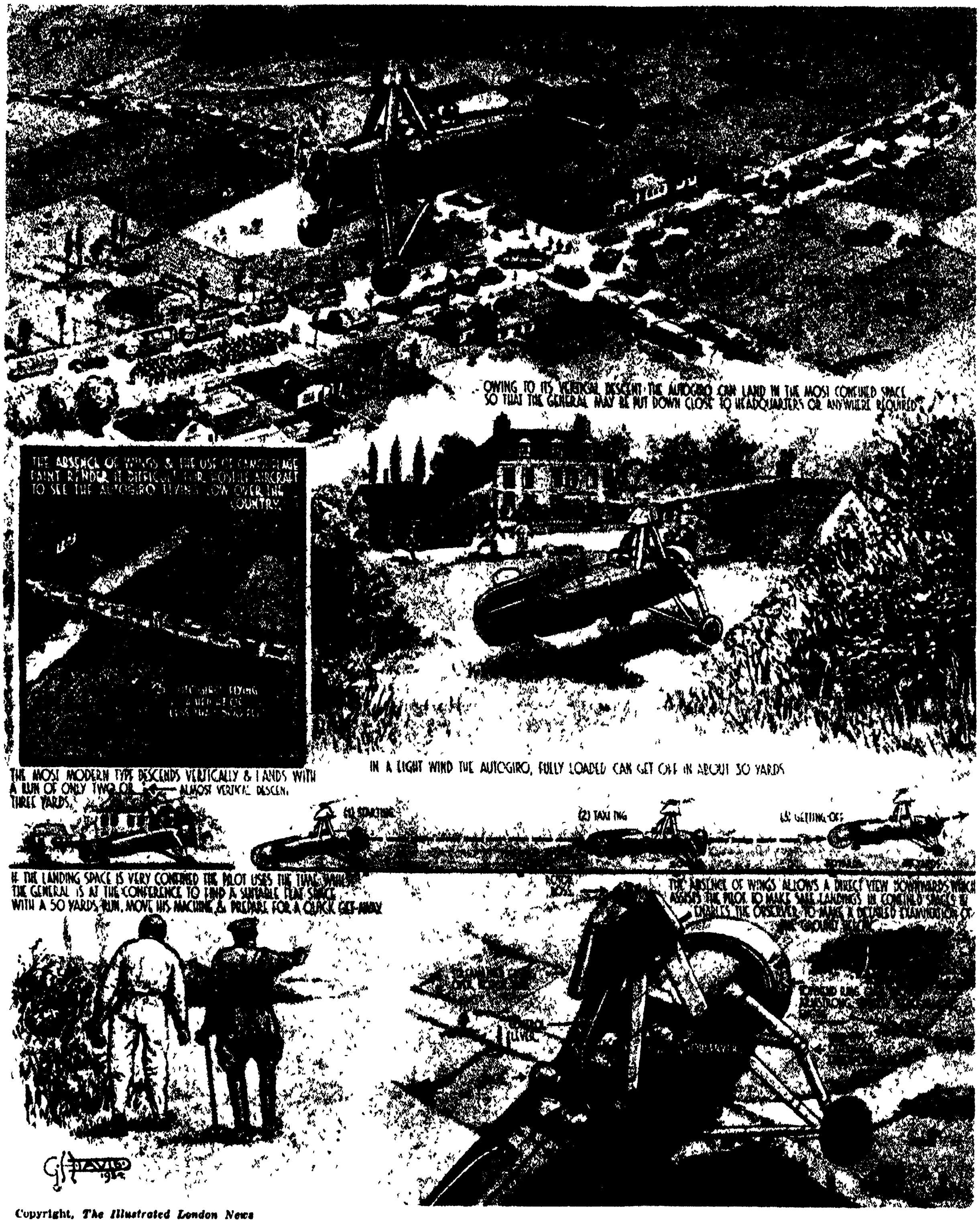
ONE of the vitally important key points of American shipping, which the military forces of the United States must be prepared at all times to defend against any invader, is the Panama Canal. To accomplish this, new 14-inch railway guns and emplacements for them have been developed. In ingenuity of construction, ease of operation, and mobility, these guns rival anything that has ever been produced. Placed in the Canal Zone, they represent a definite step forward in defensive armament and should serve to make the Canal safe for shipping regardless of the designs of belligerents. A two-page wash-drawing, to be published next month, gives complete details of these guns and emplacements.

Orson D. Munn

Editor and Publisher







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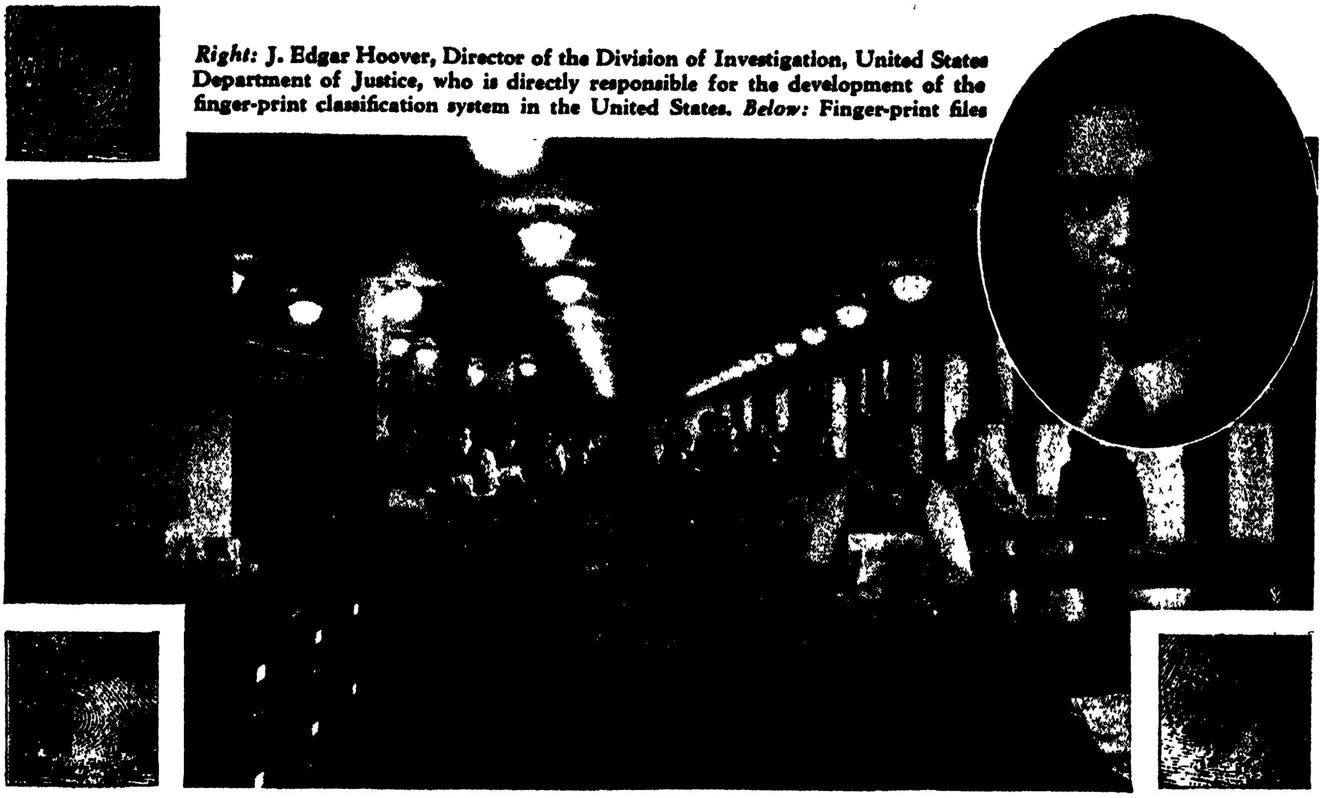
THE AUTOGIRO IN MILITARY MANEUVERS

AUTOGIROS of the latest type are now, for the first time, part of a regular unit of the R.A.F. The "C 30a" shown in the above drawing has no stub wings or movable elevators or rudders. Entire control of the ship is maintained by a single control lever which tilts the rotor in any desired direction, as shown at the lower right. The absence of wings has many advantages, not the least being improved vision from the cockpits. The desirable features of the autogiro should make the ship of extreme importance in all phases of military observation and reconnaissance, as suggested here.



Right: J. Edgar Hoover, Director of the Division of Investigation, United States Department of Justice, who is directly responsible for the development of the finger-print classification system in the United States. *Below:* Finger-print files

UNCLE SAM, ACE DETECTIVE

By HERBERT FEARON

HE swung off a freight train at a little jerk-water town in Texas. Just another hobo. Or at least so he appeared. In a day or two he would probably go as he had come, without anyone even learning his name. But the local minion of the law had a place for vagrants. A brief contact with the jail generally had a wholesome effect on an occupant—he was quite certain to depart for good as soon as released.

Turning the key on the apparently harmless, though useless individual, was only the prelude, however. The officer had been acquiring some new ideas on crime prevention, sort of a free mail-order course on crook catching. He drew from his desk a prosaic looking square of cardboard; with the help of the vagrant he placed a little data on it and dropped it in the mail. When the reply came back in a few days he hastened to put an extra guard around the jail. His hobo was a deserter from the army who had murdered an officer in France, had escaped to Spain, had killed a jailer there, had wandered through other lands, and for no particular reason at all, had stopped over at this quiet Texas town.

The scene changes. A prisoner stands before the bar to receive sentence. Apparently he will be dealt with mildly; his crime was not great. He protests that this is his first deflection from honesty. His voice betrays no quaver, his words carry conviction. But judges are becoming more particular in recent times; the tide is setting in toward life imprisonment for those whose records total conviction on three felonies. The judge looks searchingly at the prisoner and then down at his desk. From somewhere had come a story of this culprit's past, a rather long, and a rather illegal past. Again one of those squares of cardboard had performed its silent, deadly mission.

MYSTERIOUS? If you had followed those cardboards through the mails to their very prosaic looking destination you might have been even more mystified. They were delivered by the mailman at an ordinary looking office building in Washington, D. C. There keen-eyed men quickly examined a group of strange marks on them and wrote down certain numbers and letters. Their whole equipment consisted of a pencil and an ordinary magnifying glass. The large room in which they worked contained only long rows of filing cabinets, such as might be found in any office.

Not very much to work with, but sufficient to bring terror to a host of criminals, not only in the United States, but abroad. Those filing cabinets contain more or less information about the private life of approximately 2,500,000 people, but when you open the cabinets there greets your eye only an endless array of those cards, eight by eight inches, to be exact—a grand total of over 4,000,000.

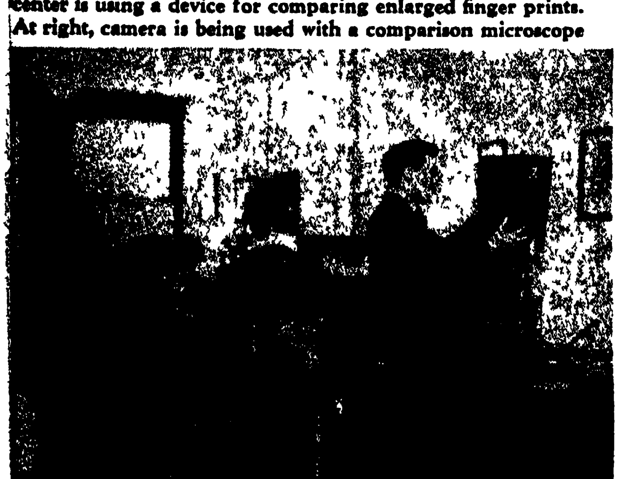
There is no possible doubt as to the accuracy of the record, for each card contains the person's signature in ink—signatures that can not be forged. Though the lines are graceful curves, they can hardly be described as specimens of free-hand movement, for most of those signatures were made under requirements of the law. They are finger-print cards and the signatures were made by the tips of ink-smudged fingers

and thumbs. It takes only about two minutes by the clock for a police officer to obtain an autograph and drop the card in the mail. But a sordid story may be disclosed when those ten inked patterns fall into the hands of the men with the magnifying glasses who move silently amid long rows of filing cabinets.

Innumerable suggestions are brought forth these days for curbing criminality. Much uninformed talk is heard about the extent and the nature of the lawlessness plaguing the country. And always there is the overtone of critical comparison of America with other countries as to expeditious dealing with crooks. But unknown to the majority who thus discuss, there is silently being built up at the nation's capital an organization that bids fair to strike more terror to the lawless than the vigilantes ever did; to place the United States in the very forefront in scientific, speedy crime detection; and to provide us with our first accurate crime statistics on a national scale.

IN 1924 the Department of Justice accepted from the International Association of Police Chiefs a limited collection of finger-print cards, on the Government's promise to develop this feature of criminal detection. To this collection were added the cards of Federal offenders, and certain others, which had been kept at Leavenworth Penitentiary. This nucleus of finger-print records logically came into the charge of the Division of Investigation, that branch of the Department of Justice which investigates all violations of Federal laws, and from which work the Federal agents, Uncle Sam's regular detective force.

In a large room were piled the boxes of cards. How was a nationwide clearing-house for crime to be constructed out of those packing boxes? The majority of law-enforcement officials in the country were not particularly finger-print conscious. They were even less familiar with the technique of finger printing prisoners. And besides, police officials, from town constables up, generally like to direct their own affairs. How could they be persuaded to adopt the idea of co-operating intelligently, with properly taken prints, to create a vast Federal crime-information bureau?



In the Criminological Laboratory in Washington. Man in center is using a device for comparing enlarged finger prints. At right, camera is being used with a comparison microscope

The answer to that question is J. Edgar Hoover. He had served as Assistant Director under William J. Burns, whose detective reputation had lifted him into the office of Chief of the Division of Investigation. On Burns' resignation Hoover was made Director. That was about the time the packing boxes were brought in. They contained approximately 800,000 cards, a rather tidy number to start with. Scotland Yard right today has only 500,000. Most foreign countries are quite compact, with few state lines to create constitutional or physical barriers. The experience of other lands, therefore, could hardly provide a satisfactory solution of the problem.

Bertillon measurements are not always a reliable means of identification. The measurements of these two Negroes are nearly identical, but the finger-print records tell a totally different story

Hoover saw the possibility of making Washington the great exchange for criminal information. He set out immediately to impress the police of the country with the soundness of his idea. His speeches before law-enforcement officials sounded more like the "service" talks of a Rotary Club business man than the perfunctory statements of a government official. He sent out literature to every city in the country explaining how to take good finger prints, and describing the equipment needed. He had standardized cards, those mysterious eight by eight pasteboards, sent out to the police everywhere with franked envelopes for sending them back to Washington.

It was evident from the start that the value of this finger-print clearing house to the police, and thus its success as a Federal venture, would be in direct ratio to the number of cards sent in. The more cards, the more records of criminals' activities, and the more complete the records the more often could the clearing house send back some positive report on cards sent in.

To get the records started—hosts of them from 48 states—and then to keep them growing chapter by chapter—that was the task before Hoover. Some areas of the country were slow to respond. Just another extension of the long Federal arm, more Washington red tape — apparently that was the reaction. But the "service" talks won. They had to win; there was no Federal law to compel co-operation.

Figures are usually rather pale, lifeless things but here's how successfully the finger-print bureau idea has been impressed upon law enforcement officials in the decade since it was started: The 800,000 cards have grown to over 4,300,000. The number of separate law enforcement agencies—constables, sheriffs, city police departments, and so on —sending in prints has increased from 987 to 6277. Not only the 48 states, but 49 foreign countries are contributing. In 1924 87,000 finger-print cards were received; in 1933 more than 500,000. But the figures that really tell the tale of the deadly threat to crookdom are these: In 1924 a positive report as to a previous record could be sent back from Washington on only 17 percent of the cards received; in 1934 the percentage has risen to almost 47. That means that on approximately every other finger-print card sent in today, some information can be returned regarding the past life of the prisoner.

In the drab office building on Pennsylvania Avenue can be seen the kind of organization that has been built from those packing boxes in ten years' time. In comes the day's mail—about 2200 cards. Here is one from the Police Department, Birmingham, Alabama—the finger prints of a Frank Taylor held on a robbery charge. That name "Taylor"

means just exactly nothing. It might have been Julius Caesar or Napoleon so far as the men with the magnifying glasses are concerned. But the F. P. C. (Finger Print Classification, the distinctive combination of letters and numbers that describes exclusively a certain individual's finger prints) might mean something. The card is taken to a certain filing cabinet. Out comes a small handful of cards for comparison. Here is one with the same F. P. C., though the name on the card is Homer George Edwards.

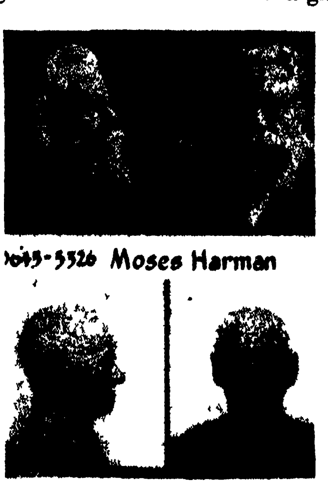
Now what has Edwards, alias Taylor, been doing? The cabinets before us do not give this information; they contain only a "master print," the best print of the crook available. The serial story is kept in a separate file, which is cross-referenced by number. Out comes the jacket with this particular number. Well, well, Frank Taylor is up to his old tricks. Six years before he had been arrested in San Antonio, Texas, on a robbery charge. He had been sentenced to the state penitentiary. Two years later he was again committed to this institution for life for murder, but was declared insane and transferred to an asylum.

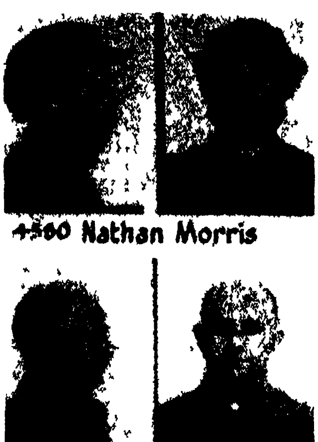
But what is this flaming red "Wanted" notice clipped to the record? Edwards had escaped from the asylum—a crazy murderer at large—and Texas wanted him back So they had asked Washington to keep a lookout for him. Perhaps he might fall into the hands of the law somewhere else, be finger printed, and thus the clearing house would be able to tell Texas the location of their man. It took only the time required for a telegram to travel, to tell the Lone Star State that its missing, murderous lunatic was in custody of the Birmingham police. And it took no longer for Texas to request Alabama to hold Taylor for them. That's a new version of the sinister triangle: sinister, this time, only for the crook.

SINCE the general use of finger prints as a means of identification, crooks do not depend so much on changed names to conceal their identity. They would give anything to change the signature on their finger tips, though. There are cases where operations have been undergone, even mutilation resorted to, in a desperate attempt to change the distinctive pattern by which they are classified at Washington.

Every month an average of 346 criminals, who are wanted for every variety of felony, or as Escapes from penal institutions, are returned by the little red slips of paper that are clipped to the crook's record in the Bureau. And yet this is but a by-product of the clearing house's activity. Its main business is to give the past record of a man, that his present captors may have as many facts before them as possible.

In another room in the Bureau stands a file such as might be seen in the catalog room of a library. It is full of cards about three by five inches in size. Each card has only one smudge of ink on it. It is a single-print file; that is, a file keyed, indexed, and with a F. P. C. in terms of a single finger print instead of the group of ten. When the Bureau decided, a year ago, to create this file it had to devise certain refinements of the regular classification system.





Further proof of the efficacy of finger print identification. These two groups of photographs show how the physical appearance of an individual may be radically changed by so-called natural disguises. Finger prints, however, remain a constant identification throughout life

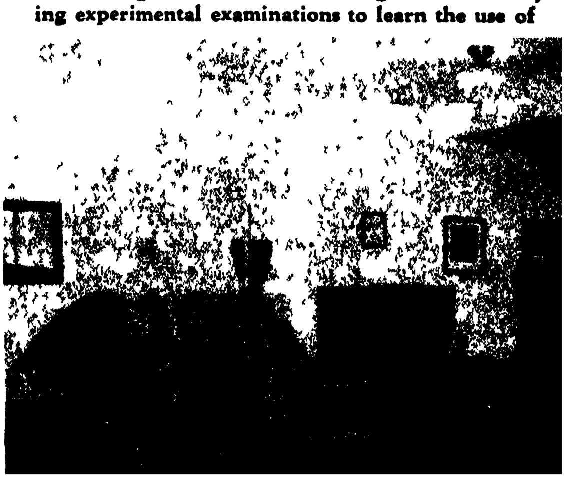
The value of this new system is immediately evident when the fact is known that under the regular classification it is impossible to ascertain whether the prints of two or three fingers found at the scene of a crime—latent prints, they are called—belong to an individual whose card is found in the Bureau file. And rarely does a crook leave prints of more than two or three fingers, if that many.

From the main file of master prints there were taken the cards of the chief public enemies in the United States, a total of 3500, and from these, separate prints of each finger and thumb were made on the little three by five cards, a grand total of 35,000 cards. Now if a major crime is committed by any one of these 3500 public enemies and he is so careless as to leave the print of just one finger tip behind him, his identity can soon be learned from Washington, and that's half the battle. This special file is now well organized. It will grow greatly beyond the 3500 present total.

But that's only part of the story. At the same time this select list was being especially honored by a tenfold classification, certain information about the criminals was being gathered—height, weight, build, complexion, hair, eyes, teeth, speech, race, dress, and so on, a total of 21 separate features, with their various subdivisions. A numerical value was arbitrarily given to each physical characteristic, thus enabling them to be compactly tabulated, like census records, by punch marks on small cards that carry corresponding numbers. Sounds a little complicated, it must be confessed, and a card bristling with numerals, with a score of the numbers punched out, looks even more bewildering. But that compact, perforated little piece of cardboard gives a very detailed description of a man, and in a form that can be handled quickly and accurately by machine.

HERE is the value of this file: A partial description has been obtained of some suspect in connection with a crime. The police have reason to believe that a member of some important gang, whose record the Bureau has, committed the deed. Perhaps they have half a dozen identifying marks he was tall, heavy, blond haired, lame, ruddy complexioned and had protruding upper teeth. They check these off on a blank provided by Washington. Six holes are punched on a card at the Bureau, an electric button is pressed, and this six-holed card is tallied against the 3500

Student agents in the Criminological Laboratory ing experimental examinations to learn the use of



A well-known Public Enemy, and his complete record, reproduced from the eight-by-eight inch card

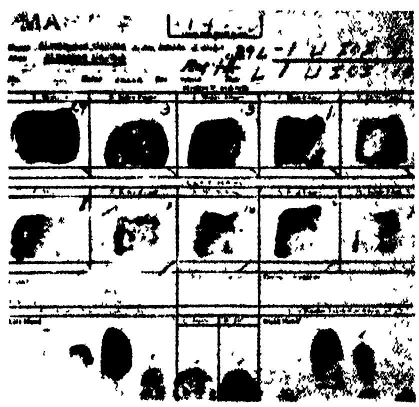
cards on file. The result is a small handful of cards that have the six characteristics in common with this new card. Of course none of these may be the man wanted, but then again, one of them may be. A full description and photograph of this handful of possible culprits is then sent back to the police. Can they identify one of them? That is their part of the program.

Strictly speaking, this special modus operandi file, as it is called, and the single-print file, owe their beginning to the launching of the Federal drive to stamp out kidnapping and extortion. From the day that kidnapping was made a Federal offense, and the task of dealing with it was placed upon the Division of Investigation, the subsidiary Bureau of Identification has been called upon to contribute its full measure of aid. That is one reason why all the kidnapping cases thus far handled by the Federal agents, a total of fifteen, have been solved, and in most instances the guilty parties are already serving sentences.

EVERY month there goes out from Mr. Hoover's office a 32-page bulletin entitled, "Fugitives Wanted By Police." In each case a brief description is given, including the F. P. C. This bulletin, which every police office receives, exacts a steady toll of crooks enjoying a brief respite from the law. This is in addition to the "Wanted" notices placed with the criminal's record in the Bureau. Few countries attempt to carry on anything approaching this in the way of broadcasting news of fugitives wanted.

In the files of the Bureau are the prints of some 160,000 persons who are on Uncle Sam's payroll, Civil Service employees. Because of the almost exclusive use of finger prints in relation to crime, the government has been slow to use them for any other class of people. But for the last five years the Civil Service Commission has, as a matter of precaution, taken the finger prints of applicants. And here is what has come to light: The first year one out of 13 applicants was found to have a criminal record; the second year, one out of 14; the third year, one out of 22; the fourth year, one out of 70; and last year, one out of 40. The rapid decrease in the number of those with criminal records probably indicates that the man with such a past is increasingly hesitant to ask for any job where finger printing is involved in the application.

Every variety of offense, from disorderly conduct to bigamy and murder are represented in the records. An echo of the Volstead era is found in the story of the man who applied for a position



as a Federal Enforcement Agent. His finger prints disclosed that he was an Escape from a penitentiary. He must have had a low estimate of the identification possibilities of finger prints!

Most picturesque of the varied services of the Identification Bureau, or perhaps most pathetic, is the use to which it is being put by private citizens. It is not an uncommon thing for prominent persons to send in the finger prints of their family for filing at Washington. They wish to make certain that in the event of kidnapping there will be some positive way to identify the loved one.

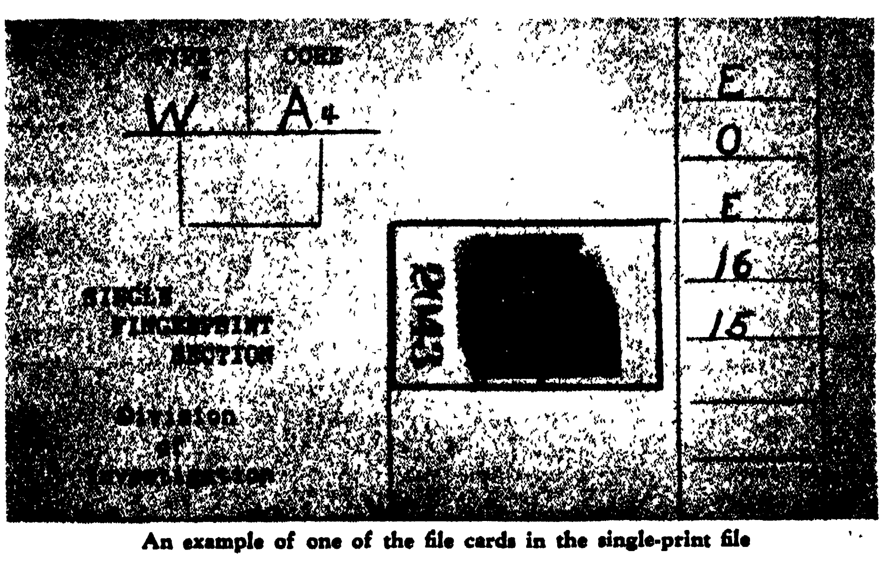
When you have spent long hours, as this writer did, following through the maze of activities in the Bureau, you come away a little bewildered, but with a sufficient understanding of its smooth workings to be convinced that here lies the greatest threat to the criminal world. There is generated in you for perhaps the first time in your American life, the feeling that the forces of law and order are really getting the upper hand. You picture what this Bureau will do in the future now that it has become well organized. But you have heard no boastful claims as to what it is doing or will do.

There is an unusual quiet about the place. But there is an *esprit de corps.* You feel it. They work against time. At first the goal was to report within 48 hours on all cards sent in. Now it is 36 hours, and where telegraphic report is requested the time element becomes negligible. They will illustrate the need for speed with the story of the telegram that came from an Oklahoma city placing a "Wanted" notice for a certain criminal, for murder. When that telegram arrived the Bureau was in the very act of answering St. Paul regarding this crook, who was being held by the Minnesota city for investigation. A little delay might have let a murderer escape. The magnifying-glass men are not planning that murderers, or any other brand of crook, shall escape.

YOU stop a moment at a desk on your way out. Telegrams are being dispatched. Birmingham is being informed that the man it wants on a motor theft charge has been arrested in Middletown, Ohio. The Escape that Missouri State Penitentiary is looking for has been arrested in an Oklahoma town on investigation. The Escape that the Reformatory in Granite, Oklahoma, wishes to lay hands on again has been arrested in Alliance, Nebraska.

Sort of winding up a few loose ends at the close of the day, they explain to you.

You go on home to enjoy the best night's sleep in many a day, dreaming contentedly of men with mysterious little glasses who catch all your enemies.



An example of one of the file cards in the single-print file

OUR POINT OF VIEW

No More War?

WHAT seems, at first glance, to be the most practicable idea for preventing war that has come to public notice in recent years—excluding the not-yet-attempted changing of human nature—is that advanced by Professor Ward V. Evans of Northwestern University. He says: ". . . it might be possible now, by properly controlling the materials upon which war depends, to prevent war entirely."

Some years ago, our War Department listed some 28 or 30 products and minerals without which many of our industries would be crippled, which would be essential to the successful conduct of a war (offensive or defensive!), and which the United States can obtain *only by importation.* It is these minerals and raw materials which Professor Evans would control. His scheme would demand an international agreement to refuse to supply warring countries with such materials, and this, in turn, would make necessary an economic census to see just what each nation needs and must import.

Suppose we evaluate this scheme in scientific language, ignoring altogether politics and diplomacy. While this journal is neutral in the discussion of economic nationalism, one side of which is taken by Mr. Gerard on page 194 of this issue, we agree with him that science has proved capable of supplying synthetic substitutes for many necessary things in times of emergency. England cut off Germany's supply of tungsten for high-grade steels during the World War and Germany turned to molybdenum and made a good steel for her war material. England then cut off the supply of molybdenum and German scientists made an excellent steel using nickel.

Two of the favorite raw materials which, it is claimed, might be our undoing, should our imports of them be cut off during war time, are crude rubber and manganese, the latter for steel manufacture. In our September issue we discussed an adaption of DuPrene ("synthetic rubber") to the manufacture of tires that are as satisfactory as those made of plantation rubber. DuPrene is expensive but at any rate it is a scientific product that *could* solve a war-time rubber problem. As for manganese, it has been said that this country possesses only some low-grade ore, but we have reason to believe that, like the report of Mark Twain's death, this report has been grossly exaggerated. We believe there are rich manganese ores in this country, the mining of which has been prevented—for reasons.

As SCIENTIFIC AMERICAN is unalterably opposed to war, in principle, we wish there were some possibility of putting Professor Evans' scheme to the test. Because science is so utterly efficient, however, this seems a vain hope. War or no war, science will continue finding something new that is better than the old!

Light and Death

WHILE automotive engineers apply their utmost skill to improve motor cars in every conceivable way, with an eye cocked toward the sales department, a grisly graph follows the curves of their production sheets. Latest records show 31,000 motor-vehicle fatalities in 1933, or 5 percent above those in 1932. We cannot hope ever to control entirely the human emotions that cause accidents due to carelessness; it seems next to impossible to protect the motorist against himself by enacting regulatory laws that are so frequently broken. But there is one cause of accidents that can and should be carefully considered by every community, and the remedy applied.

Fatal accidents at dusk or after dark have been on the increase, but a study of the situation shows that where streets are provided with the best light, accidents have decreased as compared with streets where the lighting is poorer. For example, it has been shown that between 5 and 8 P.M., when it is light in summer but dark in winter, winter fatalities exceeded those during the summer months by nearly 100 percent. In cities with better street lighting, however, the excess of fatalities in winter is much less. Where street lighting cost over $1.50 per capita, the winter fatalities were only 32 percent in excess of summer, while in cities with a cost below 50 cents, the excess was 140 percent.

The remedy is obvious. Street and highway lighting facilities have been constantly improved, in step with the improvements in motor-car construction, but many communities have been backward in availing themselves of the improvements and thus protecting their citizens. In fact, many budgets have been reduced for purposes of economy by the extremely unwise move of curtailing street lighting. When less light and more deaths go hand-in-hand, every motor vehicle fatality on a poorly lighted street or highway constitutes a potential charge of accessories to murder against those responsible for the inadequate lighting.

Trees

THE fact that a 75,000,000 dollar tree-planting project in the middle west has been authorized, and that preparations for realization are now going forward, lends added proof to the shortsightedness and selfishness of man in the development of the United States. Where once stood mighty forests of virgin timber will now be found vast stretches of denuded territory, swept by burning winds in the summer, stripped of fertile top-soil by the action of rains that run off unimpeded, and practically worthless.

This is the work of man who ruthlessly cut down forests for the lumber, without thought for the future or for the effects which might arise from logging operations on an uncontrolled scale. Now the harvest has been reaped, and at this late date something is to be done about a situation that has become so acute as to constitute a national menace. To restore in even small measure the forests of only a few years ago will require generations, but a start has been made. The administration is to be congratulated on the splendid scale on which is based the proposed tree belt in the middle west; let us hope that politics will not interfere to prevent carrying the project to a successful conclusion.

SCIENTIFIC AMERICAN has for years advocated conservation of our natural resources, and reforestation where needed. We now wish to add our voice in support of a proposal made by Charles Lathrop Pack, of the American Tree Association, for the planting of town forests, a project which every community can undertake for itself. It is obvious that such forests, patterned according to local conditions, will provide employment at the present time, and shelter and soil protection when grown.

The farmer, also, can do his share, especially in regions where trees have been thoughtlessly eliminated from the landscape. Let him plant trees near his house and outbuildings—trees that will add to the esthetic value of his property, provide grateful shade in summer, and help to reduce the devastation wrought by alternating burning droughts and overwhelming floods. If all concerned will co-operate to the common end, many of the effects of man's misdirected meddling with nature can be overcome.

STRIKES, BUSINESS, AND MONEY

By JAMES H. RAND, JR.
President Remington Rand, Inc.

IN a desire to make for our readers a fair appraisal of important and timely economic problems, we asked Mr. Rand—who is Chairman of the Committee for the Nation to Rebuild Prices and Purchasing Power—to prepare the accompanying article. Taking no sides ourselves except that we do see great danger in inflation, we hope soon to be able to present a further discussion on monetary—and, therefore, industrial prosperity—problems in an early issue. As to the conclusion to be reached, the reader will have to be the judge.—*The Editor.*

THE immediate danger, gravest for our country, is not the violent recurring strikes from coast to coast. It is the possibility that we may be misled into failure to see what is causing these strikes, and fail to remove that cause. The greatest danger is that, in blind resentment against some ill-advised policies, we might overlook the corrective steps that are indispensable to America's recovery.

Whether it is evidenced in San Francisco, Amsterdam, or Chicago, a demand to overthrow the existing social order thrives on deflation. The widespread disorders in Holland, the threats to stability of other governments of the European "gold bloc"—all an index of unbearable deflation—have come at a time to help us interpret similar unrest in the United States.

It should have been apparent for a long time to our financial leaders that we had gone beyond the limits of "safe" deflation. They should have realized that unless we restored commodity prices and taxable values and employment before the economic cancer of deflation reached the vitals of American institutions, the profit system could not survive.

Our financial leadership, clinging to its gold standard traditions, has been slow to realize, slow to admit, slow to face this challenge, and quick to oppose all who did recognize and did face it. Some still appear to believe that capitalism and our free American institutions would be safe and that all would be well if we simply would vote this fall to return to what we had in 1932.

I do not believe it. When the Dutch riot—those phlegmatic, precedent-respecting, law-abiding Hollanders—when they break out in strikes and Communistic riots, anything *can* happen, anywhere. We are no more sparkproof than the Dutch.

Many farm leaders and some business men have taken the trouble to find out that the depression came from monetary causes. The five-year fall in commodity prices resulted simply from the increase in the purchasing power of our gold dollar. This threw economic groups into disparity, killed purchasing power, created unemployment, destroyed for business the opportunity to make profits.

The evils that flow from monetary derangement can be corrected only if the monetary system is soundly rebuilt. Therefore no Congress ever had to make policy decisions so vital to America as the one about to be elected. It can either plunge us further into the socialistic trend—or it can reverse this trend.

Because the United States was the last of 34 nations to raise its price of gold and then hesitated to raise it far enough to restore economic balance, we have been rushed into socialistic experiments in government control that undermine American industrial leadership.

WE were tied back last February to a fixed weight of gold and its consequent deflation, but the public was not told that this was to be government policy. They had to wait to learn it from the report of the Bank for International Settlements issued in Switzerland on May 14.

If industry wishes to be free, it must insist upon reflation. It must insist that the half-executed program to restore and thereafter keep stable the value of our money shall be carried through. This requires that legislators irrespective of party must possess *monetary understanding* and that they be supported by an educated public opinion.

Economic groups must be brought back into price balance so that they have purchasing power for one another's products. Price level restoration will rebuild employment and profits and scores of billions of security and real estate values which were wiped out by deflation. Prompt restoration of prices and profits would cut the ground from under the argument that regimenting industry and agriculture is necessary.

Let me review briefly the facts that bear on this problem of our money and its relation to the social unrest that we all dread.

The world has in the last five years put a new value on the commodity gold. A fixed weight of gold, say one ounce, buys today two and one half times as much of *basic* commodities as it did on the average in the years 1926 to 1929. This represents a rise in the value—that is the real purchasing power—of gold of 150 percent. The new, excessive value the world has given to the commodity gold in the last few years has been due to panicky world demand for gold, and failure to discover any great new sources of gold supply.

The world dictates the *value* of gold, but each nation determines its *price* of gold in terms of its own dollars, francs, pounds, and so on. Fix that point in your mind. *It is all-important in understanding this problem.*

Failure to offset this rise in *value* of gold by adjusting our *price* of gold pulled down the price of everything that is measured by gold and thereby wrecked our economic system. To correct this rise of 150 percent in the world *value* of gold, we have increased our price of gold only 69 percent.

If a lumber dealer were told that the yard measure had increased to 2½ times its former length, he would instantly know that business on the old basis had become impossible. If the change occurred imperceptibly over five years, when he discovered it he would know he had become insolvent. He would move to correct the yard measure—not part way, but all the way.

But instead of demanding that this same correction should be applied to our dislocated measure of value, many business men have acceded to policies that undermine their own leadership and may endanger the institutions of their country. They have listened to advice of some of our international bankers who say that to correct this distorted

measure of value would be dangerous "tampering" with the false gold "yardstick." Failing to see—or refusing to admit—that this change in the "yardstick of value" really caused the depression, they subscribe to the mass delusion that it was "over-production" by agriculture and industry.

Habit-thinking, as in all old institutions, is so firmly lodged in the international and central banking world that its gold traditions must be broken down from the outside. Industry and agriculture, the producers of real wealth, have a responsibility to themselves and to their country to help solve the problems precipitated by a breakdown in the monetary mechanism. If necessary, they must insist that financial leaders shall accept necessary reforms.

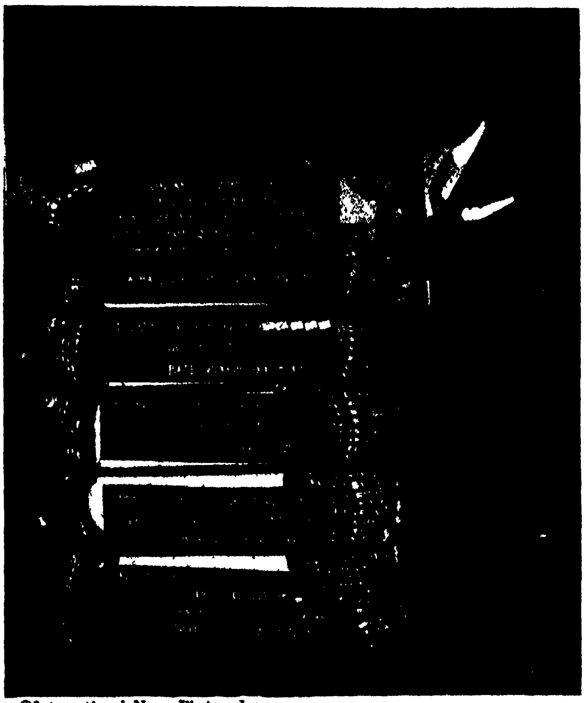
The immediate task before us is to fight off the renewed efforts to tie our dollar to a price of gold too low—the very cause that brought on the deflation of the past five years. What too low a price of gold means to American industry and agriculture can be seen by examining what has happened to basic commodities.

FARMERS produce mainly basic commodities. (The easiest way I know to remember what are the "basics" is to catalog the principal foods, fibers, and metals of world-wide use which supply man's primary needs for food, clothing, and shelter—the necessities of life.)

Regardless of credit expansion and contraction, the world price of basic commodities follows the world *value* of gold—because gold is the only world money. Each nation's general price level follows, with some delay, the level of its basic commodities. Therefore, if a nation cannot live with its domestic price level dragged down to the low level of world prices expressed in gold, it must raise its *price* of gold. That is, in order to offset the smaller amount of gold which the world will give for commodities, each nation must divide the gold ounce into more units of its own currency—dollars, shillings, francs, etc. The alternative is to suffer needless deflation and wait in hope that the world will stop hoarding and change the value it gives to the commodity gold, or that vast new gold fields will be discovered before it is too late.

The meaning and importance of "raising the price of gold" become clear and easy to understand if we follow through a typical basic commodity, such as cotton.

A bale of cotton was exchangeable the world over for five ounces of gold, or its equivalent in any country's money, only five years ago. In every part of the world today it is worth around 1½ ounces of gold. All other farm products have fallen similarly in value, in terms of gold—and, generally speaking, have not risen. We have 11- to 12-cent cotton only because we have changed our *price* of gold. Cotton the world over is still worth substantially no more in gold than it was when we had 6-cent cotton. Destroying American cotton did not affect its world value. It only caused other countries to plant more!



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The first bale of the 1934 cotton crop, bearing placards telling a story of gold which is significant

Farm income between 1921 and 1929 ranged around eleven billion dollars—that is, approximately 500 million ounces of gold, or the currency for which that much gold could be exchanged when our gold price was 20 dollars an ounce. By 1932 our farm crops brought only 200 million ounces of gold or its currency equivalent. Why? Because gold had changed in *value*, and we had not changed its *price* in dollars.

The Hoover administration, under the habit-bound advice of the Federal Reserve and international banking leadership, kept the price at 20 dollars. Therefore, with the value of our farm crops reduced from 500 to only 200 million ounces in gold, farm income was reduced to four billion dollars in 1932.

Most of the countries that are farthest out of the depression have raised their price of gold 100 percent—some more. By going up only 69 percent—to 35 dollars an ounce—and stopping there, President Roosevelt restored farm income to only seven billion dollars. With increased taxes and public debts, unchanged freight rates and fixed charges, this seven billion dollars does not leave the farmer enough money to buy any volume from industry.

Congress delegated authority to the President under the Thomas Amendment to raise our price of gold a maximum of 100 percent—from $20.67 to $41.34 an ounce. Economic "orthodoxy" predicted (mistakenly) that disaster would follow any departure from our old price of gold. But for deflationary influences opposing and deterring prompt and forceful action for recovery, we should have been much further on.

Prompter recovery in the United States, increasing the demand for world commodities, might have helped halt the world flight of liquid capital into gold for hoarding. Instead, gold continued to appreciate. Between March, 1933, and March, 1934, the commodity gold gained 20 percent more in value. That is, the average of basic commodities worth 100 ounces of gold in 1926, exchanged for only 48 ounces in March, 1933, and now exchanges for only 40 ounces of gold.

I HOPE that before this article appears in print, President Roosevelt will have taken command of the ship—taken it out of the influence of the deflationists and internationalists—and acted on the gold price with the same forthrightness he displayed when he put domestic price level recovery ahead of international exchange stabilization at the London Economic Conference in July, 1933.

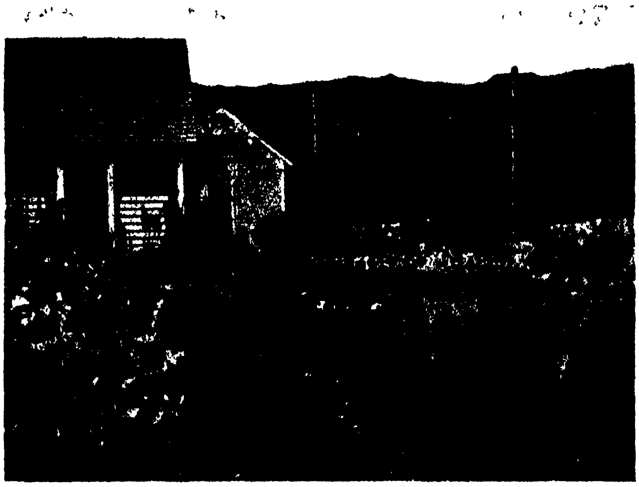
If the President will do this, using in full his gold revaluation authority under the Thomas Amendment, he can immediately restore 1¼ billion dollars of additional farm buying power. From $35 to $41.34, a rise of 18 percent, should bring a corresponding rise over last year's seven billion dollars of farm income. At this writing, published estimates indicate that drought-made higher prices and lower yields, plus AAA "benefits", will leave farm income at only seven billion dollars.

President Roosevelt has only two ways to fulfill his promise to restore the nation's price level. One is to raise the price of gold adequately. The other is by printing press inflation.

The gold pricing policy has worked. Basic commodities have risen as much on the average as the rise in our price of gold. Basic commodities can go no higher with gold at 35 dollars an ounce —unless the world lowers its present value of gold.

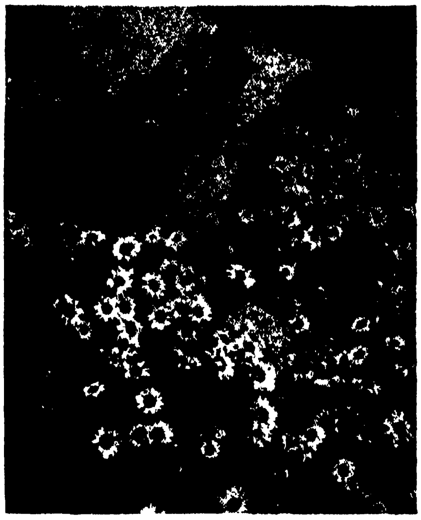
To wait for complete recovery until the world *value* of gold falls of its own

(*Please turn to page* 221)



A fine flower garden and lawn in Skagway, Alaska, near the Yukon Territory

A prospector and his vegetable garden near the shore of Great Bear Lake



Arctic daisies blooming at Chesterfield, on west coast of Hudson Bay

Radishes grown at Bernard Harbor, 250 miles north of the Arctic Circle

A poppy-like flower in bloom near the Arctic Circle on Baffin Island

FLOWERS IN THE ARCTIC

By JAMES MONTAGNES

THE Arctic may have heavy snows and bitter cold for eight or nine months of the year, but during the remainder of the twelve months flowers bloom, meadows appear, and even in the most northern settlements vegetables grow. These are facts, backed by photographs, brought out to civilization by Canadian government explorers, by fur traders, missionaries, prospectors, police, and others who live in the far north.

Flowers have been found growing within 400 miles of the North Pole by investigators who traveled to the tip of Ellesmere Island, the last big Arctic island before reaching the Pole. There these botanists found hundreds of varieties of flowers, mosses, lichens, and similar plants.

Practically the entire northern mainland of Canada, which in winter is a white barrens, in summer is a grassy plain, with few trees, but rich grasses on which feed innumerable caribou, musk-oxen, and lesser sized animals. In fact there is so much grass there that investigators looking for a place for a reindeer herd to graze, found one 15,000 square mile area in the western Arctic near the Mackenzie River where the growth is heavy enough to take care of a herd of 250,000 animals the year 'round.

AT the settlements, where the long Arctic day averages upwards of 18 hours daily during the summer months, it is possible to grow a large assortment of vegetables, including potatoes, cauliflower, cabbage, tomatoes, radishes, onions, carrots, beets, lettuce, and cucumbers. In a region where canned food, dried meat, and fish form the staples, these fresh vegetables prove an attraction on the menu. Even wheat has been grown in the far north, and experiments are now being carried on to find a faster maturing wheat for that region.

Anyone expecting to find a barren region in the far north in summer has to change his mind when government reports state that beautiful blue lupines, yellow Arctic poppies, white and red saxifrages, blue forget-me-nots, Arctic daisies, rhododendron and other flowers dot the plains in summer. The Arctic is not entirely barren—at least not during the warm months.

Excavations in Ancient Athens

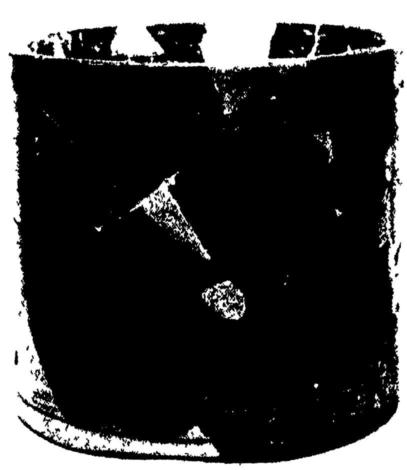
By T. LESLIE SHEAR, Ph.D.
Professor of Classical Archeology at Princeton University

THE past season's excavations in the Athenian Agora, which were conducted by the American School of Classical Studies at Athens, produced most important topographical results. The discovery of two buildings of which the identity is certain made possible the identification of all the more important buildings which had been hitherto cleared, and thus solved a long-standing and much debated archeological problem.

One of the new buildings is the Tholos, which can be identified with certainty because of its circular shape. It has a diameter of 60 feet. In the earlier records it is usually called the Skias. This word, meaning sun-shade or umbrella, was presumably applied to the building because of its conical roof. The Tholos was used as a dining hall for the officers of the Council and in it were deposited the standard weights and measures of the Athenian state under the guard of a public slave.

The circular floor of the Tholos. Its discovery led to identification of near-by buildings. Theseum in background

An official measure was found close to the Tholos. It is a round terra-cotta bowl of which the capacity is about two quarts. It is stamped with the seal of the city that is familiar from the coins—the helmeted head of Athena on one side and on the other the double-bodied owl. On its surface is painted the word "official." This may be the standard Attic dry measure, the choinix, which was the daily ration of wheat for the Athenian laborer. Standard weights were also found in the vicinity. One lead weight, which weighs 710 grams, is stamped with a dolphin and with the letters M N A. It presumably represents an Attic mina. Another lead piece with a cornucopia stamped on it weighs 71 grams, and a bronze weight, on which an owl is incised, has a weight of 69.9 grams.



Official measure mentioned in the text, stamped with the city seal

THE second important building that was found is the Altar of the Twelve Gods. Its identification was provided by a statue-base, standing in front of it in its original position, which bears an inscribed dedication of Leagros, son of Glaukon, to the Twelve Gods. The building is located at the extreme north end of the west side of the American Zone of excavations, and the greater part of it extends beyond the area and lies beneath the tracks of the Athens-Peiraeus electric railroad. The investigation of this building gives an illustration of the difficulties inherent in archeological research in the heart of a modern city. For two weeks it was necessary to dig between the tracks with trains passing at ten-minute intervals. But the results were satisfactory and all the essential architectural details of the structure were secured. The altar was not only a sacred place of asylum but was also used as the starting point for measuring distances from the city.

The statue of Aphrodite described in the article. Through sheer luck, it had been preserved

With the position of these two conspicuous buildings definitely determined it has been possible to identify all the buildings on the west side of the Agora, in the order of sequence in which they are mentioned by Pausanias. Passing north from the Tholos they are the Bouleuterion, the Metroön, the temple of Apollo Patroos and the Stoa of Zeus Eleutherios. Thus the whole topographical problem of the Agora has been clarified.

Among the many important objects discovered in the course of the past season a marble statue of Aphrodite is especially beautiful. The goddess is holding part of her cloak up behind her with her raised right arm and is resting her left arm on the trunk of a tree. A small figure of Eros is perched on her left shoulder. The statue was built into an early Roman wall which may date from the reconstruction of the city after its capture by Sulla in 86 B.C., and it is, therefore, certainly a work of the Greek period. From its style it should be dated in the 3rd to 2nd Century B.C. A head was lying in the wall by the statue. It is the type of an Aphrodite head and its size, style and technique are appropriate to the statue, but it does not make an exact join with the neck of Aphrodite. In the photograph it is shown attached to the statue by means of a layer of plasticene.

BY the end of the current season six of the sixteen acres in the American Zone had been cleared. The deposit of earth above the level of classical times varies considerably, but the average depth is between ten and fifteen feet, and during the four campaigns of excavation 60,000 tons of earth have been carted away. It is estimated that it will require five more seasons' work to complete the excavation of the entire area.

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Where does the ether concept stand today? Next month this vexed question will be discussed.—The Editor.

A Chapter of Accidents and How

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Society for the Advancement of Science

TWO generations ago, when the spectroscope was new, a good deal of interest was excited by lines which appeared to be common to two or more elements. There seemed a chance at first that these lines might come from some fundamental constituent of matter contained in many kinds of atoms, but this turned out to be a dream. Some of the coincidences turned out to be due to traces of impurities in the "chemically pure" materials which had been used, and the chemists were not to blame, for the spectroscopic tests were far more sensitive than those which had previously been available. The rest proved to be mere chance agreement. When the spectra each contain thousands of lines, it will happen now and then that two quite unrelated lines of different substances fall so close together that even the most powerful instruments fail to separate them. Precise measures usually show that, though the two lines overlap, their centers are not exactly coincident. But occasionally the agreement is almost exact.

Cases of the sort have been a good deal of a nuisance to observers, for a lot of extra work has had to be spent to make sure whether one is dealing with a real though casual agreement of two different lines or an effect of impurity, and occasionally even the elect are deceived. (The great Rowland himself attributed a pair of solar lines to both iron and copper, when the latter one was responsible.) Again, only too often the investigator seeks some faint line in sun or star, only to find that it is hopelessly masked by some close and powerful neighbor. But never till now has such a coincidence of two lines helped to solve a problem instead of obstructing the way.

AT various times we have told in these columns of the steady advance in our understanding of the gaseous nebulae. Everyone knows now that the strong lines characteristic of these bodies, and very hard to match in the laboratory, come from familiar elements such as oxygen, nitrogen and sulfur, but are "forbidden lines" which are emitted only by atoms which have been left alone for long intervals—sometimes a second or even a minute. In an ordinary "vacuum" tube there are still so many atoms that they bang into one another thousands of times a second and upset the process—which is not really forbidden but only dilatory. But the nebulae are so excessively tenuous that the atoms are no longer bothered by their neighbors, and have plenty of time to finish their jobs.

Most of the nebular lines are of this sort, but there are a few ordinary lines emitted by atoms which release their loads of energy within a hundred millionth part of a second or so, instead of having to wait millions of times as long. Hydrogen and helium (which have no forbidden lines, except one very far in the ultra-violet) show their ordinary lines. So do oxygen and nitrogen, but in this case only a few lines out of a wide spectrum appear. Those which show up are strong lines, to be sure, but others as strong or stronger are entirely absent, even though they are closely related to the others. It is as if one of the yellow sodium lines should appear without its mate.

SOMETHING queer must be happening, and Dr. Bowen, the discoverer of the forbidden lines a few years ago, has found out just what it is. To understand the remarkable chain of events we must refresh our minds for a moment and recall why these nebulae shine.

Gaseous nebulae are not incandescent like the stars—they are not even hot—and they would be quite invisible if energy were not steadily fed into them from stars near by. In the roundish planetary nebulae the "exciting" star forms the nucleus of the nebula itself. In irregular forms, like that in Orion, the star is near by but not itself within the gas cloud. Cooler stars merely light up the cloud feebly by reflected light, but a star which is as hot as 25,000 degrees at the surface starts things going. It emits a flood of very short ultra-violet waves. When these fall on the gas they are absorbed by the atoms and knock electrons out of them. The resulting ions may be hit by still shorter waves and have another electron removed, and so on. The free electrons fly about until, after hours or days, each meets some one of the battered atoms and recombines with it—by stages the newly formed atom settling down from one state to another and giving off ordinary lines every few hundred millionths of a second, until it gets to a state from which it cannot go further except by means of a "forbidden" transition. Then it waits for a second or so, gives out one more quantum of radiation, and at last comes to rest in its normal state. We see the light given out by hydrogen and helium atoms which are doing this, doubtless because the gas is mainly composed of these elements.

SO much for the atoms; how about the radiation which they emit? The light given off in the earlier stages of the process consists of fairly long waves, and gets out of the nebula into space—for it can be absorbed only by excited atoms, and there are very, very few of these. But in the last step of the process the emitted light is of very short wave-length and is powerfully absorbed by any atom of the same kind in its normal state. Before it has gone far it will be trapped by some such atom, only to be released again and fly off in some other direction. After wandering thus, it will sooner or later get near the edge of the nebula and escape without being trapped on the way; but there will be a lot more radiation of this sort flying about inside the nebula than escapes from its surface.

For ionized helium, which is present in great quantities in the more strongly excited nebulae, the strongest line of the type just described is at 303.780 angstrom units. Now, by one of the accidents of which we spoke above, there is a line of oxygen (doubly ionized) at 303.799 angstroms. No spectroscope exists which could show the two lines separated. A quantum of light sent out by a helium atom may therefore be absorbed by an oxygen atom, raise it from its normal state, and load it up with energy. After a very short time it will unload, giving out light. This can happen in several ways, and there are various successive stages by which the original state may be restored. Even so, only a few of the many light-emitting processes of which the oxygen atom is capable are selected by this mechanism.

Now, exactly these lines (so far as they lie in the observable region) and no others, are found in the spectra of the nebulae. The mystery of the absence of

It Affects the Nebulae

the other oxygen lines is now cleared up. Nature has for once performed an experiment such as ingenious experimenters sometimes accomplish in their laboratories, and stored up a set of atoms in one alone of the many possible ways. Instead of "walking around on the keyboard of the piano" and playing all the notes at once (as Professor Wood once put it) she strikes on a single key and helps us to find how the machine works. But this is not all. There are a few nitrogen lines (again of the doubly ionized atoms) which show in the nebulae to the exclusion of their fellows.

Now Bowen's calculations show that many of the oxygen atoms which have been stirred up by the helium line, and have emitted the observed lines in the near ultra-violet, will then give out a line at 374.435 *A.*, while nitrogen atoms absorb lines at 374.434 and 374.442. This coincidence is even closer than the last, and there is no doubt that the nitrogen atoms are set shining in this way. Once again we find only the lines predicted by this theory.

Even in the marvelous realm of modern astrophysics nothing stranger than this has been found. Light from a hot star falls on helium atoms and is absorbed. Part of the energy is released as visible light, the rest as short waves which are absorbed by oxygen atoms which again give out visible light and release short waves which stir up nitrogen atoms. It is a regular "house that Jack built!" Depending as it does on *two* fortuitous and almost perfect coincidences between lines of different elements, it is about as improbable an affair as could be imagined in a "random universe." But is the universe a random affair, anyhow?

BEFORE we leave the nebulae, we should report on some interesting identifications of other lines in their spectra. The strongest lines which remained unclassified a year ago (in the violet, at 3869 and 3967) were identified as forbidden lines of Ne^{III} (doubly ionized neon) by Boyce, Menzel, and Paine at Harvard and independently by the Swedish physicist Edlèn and the Belgian, Swings. More recently a pair farther out, at 3346 and 3426, have been recognized by Edlèn and Swings, and also by Bowen, as forbidden lines of neon, stripped of four electrons. To do so much to the atom requires very strong excitation—which explains why the images of a nebula, photographed (through a prism) with these lines, are the smallest of all. The very short light waves which have sufficient energy are absorbed before they can go beyond, while longer waves, capable of exciting lines of lower energy, get farther. Edlèn and Swings have also found that two faint nebular lines at 4711 and 4740 are almost certainly due to argon three times ionized. Like the rest, they are forbidden lines. In this, as in the preceding cases, the identification rests upon the prediction of the positions of these lines by comparison with known lines in other spectra of similar structure. This can now be done with considerable accuracy and there can be no reasonable doubts of the final results of this kind of comparison.

There is no danger, though, that the nebular observer will have to rest on his laurels and contemplate only a completed work. For example, Mayall at the Lick Observatory has studied a nebula (N.G.C. 4151) which looks like a spiral nebula on the photographs and has an enormous radial velocity, 950 kilometers a second (receding, like all the spirals). But its spectrum is predominantly gaseous, showing forbidden lines of oxygen, sulfur, and neon, including the high-excitation lines of Ne^{V} in the ultraviolet. There is also a continuous spectrum, apparently coming partly from very hot stars and partly from those of moderate temperature, like the sun. Hubble estimates the distance of this object as five million light-years. What gigantic masses of luminous gas must these be to reveal themselves at this distance!—*Lowell Observatory, Flagstaff, Arizona, July 30, 1934.*

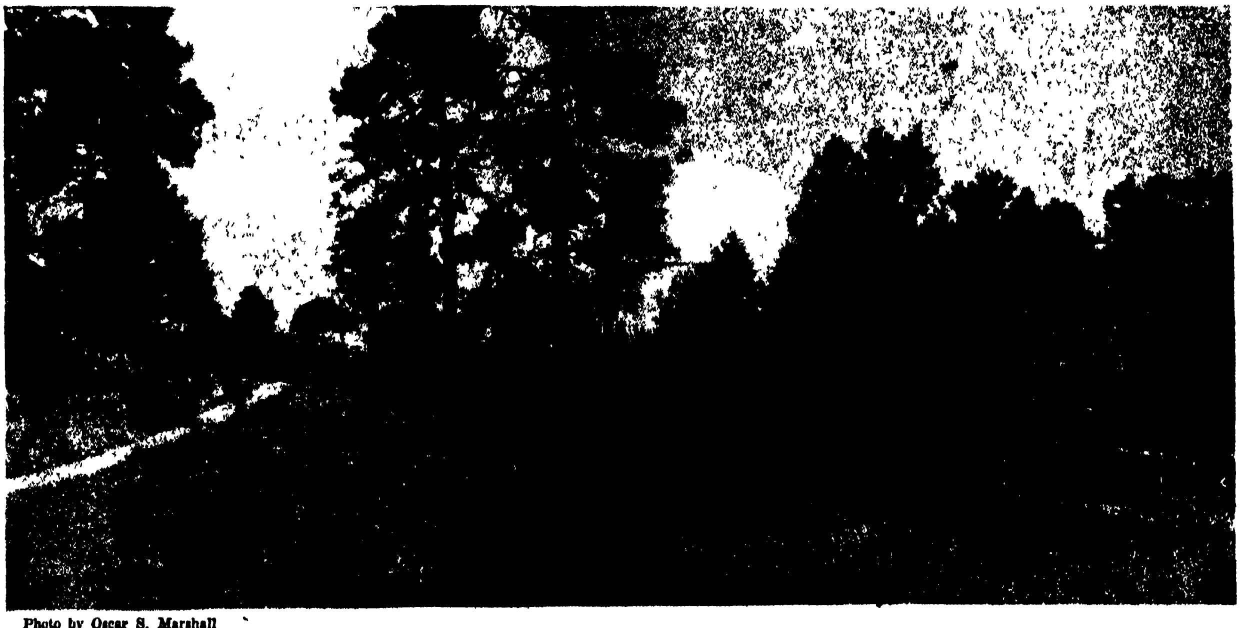


Photo by Oscar S. Marshall

This month Professor Russell's article was written at Lowell Observatory, where he generally stops when en route to the Mount Wilson Observatory to do research work. View at Lowell Observatory. The nearly cylindrical dome of the 24-inch refracter shows between the trees. This refractor has an objective lens made by Clark and regarded by astronomers as the finest in existence. The Observatory also has a 42-inch reflector by Clark, a 15-inch reflector by Petididier, and a 13-inch photographic telescope. The dome which shows near the left of the picture is Percival Lowell's mausoleum. The Observatory lies at an altitude of 7250 feet, on a dry plateau. The grounds are covered with pine forest of dense young growth, which influences favorably the observing conditions, for it largely overcomes the disturbing effects of heat radiation

ALONG CAME A SPIDER...

The Little Black Widow Spider, Common in this Country, is More to be Feared than the Tarantula

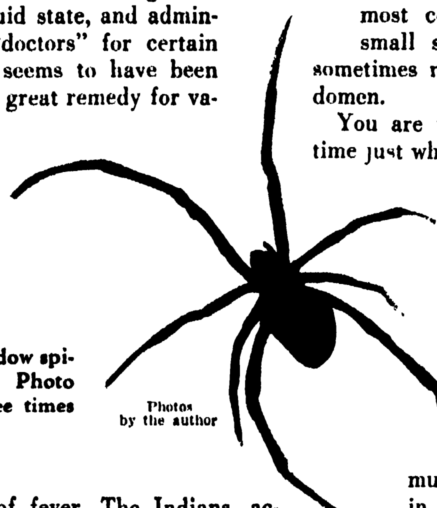
By NELSON WM. BAKER

WIDOWS, it has been said, are dangerous, but there is one widow that has been attracting my attention. She is beautiful, in her way, and her snare is always set for the unwary. The lady in question is none other than the black widow spider, *Latrodectus mactans*. She has other aliases in various sections of the United States, such as hour-glass spider, shoe-button spider, and similar appropriate or local cognomens. Her reputation is universally bad wherever she is found; which is, as entomologists and arachnologists agree, from New Hampshire to Patagonia in the Americas. In France, Italy, and Russia, particularly, her close relatives have been brought to the direct attention of scientists. All these forms are similar to our own black widow, so well known and so much discussed in the United States in connection with her venomous qualities.

The arachnida, of which black widow is a member, is a group of animals that has been shunned by man as creatures of venomous mien, hiding away in dark corners waiting to sink virulent fangs into the flesh of any unfortunate soul who crossed their path. The group includes the spiders, scorpions, mites, harvestmen, and other more remote forms. The first two are familiar to most of us, either by name, picture, or reputation, if not by personal contact. Although in the tropics there are certain huge individuals of both the spider and scorpion families which can inflict serious and sometimes fatal wounds on humans and animals alike, in the United States there are only two spiders which we can consider really poisonous—the tarantula and the black widow. The latter is to be feared far more than the tarantula, whose bite occasionally results in blood-poisoning, not from his venom but from decayed matter on the fangs.

THE black widow is common in the United States, especially in the southern and southwestern states. In southern California last summer I can safely say that in at least eight out of ten instances I could produce from one to ten spiders from the dwellings and outbuildings in the suburbs of Los Angeles. About the outside foundation, garage, and flower beds of my own home I counted over 25 of the ladies in one evening. Texas and the southern states have their share of widows, the spider being as prolific there as in California.

In Mexico and Lower California the black widow is greatly respected, even though her presence seems to be taken lightly. One writer states that in premodern times the bodies of Latrodectus were collected, mashed or ground to a thick fluid state, and administered by "doctors" for certain ailments. It seems to have been considered a great remedy for various types of fever. The Indians, according to another prominent scientist, were aware of the venomous nature of the spider, and developed a poison for their arrows from the mashed bodies.



The black widow spider is small. Photo enlarged three times

Photos by the author

The *malmignatte*, *Latrodectus tredecimguttatus*, of Italy and presumably of other European countries, is similar to our "lady in mourning," but slightly smaller in size. She is greatly feared in southern Italy, and her bite is reputed to be fatal to dogs and live-stock. In certain seasons of the year the countryside is scourged by locusts, grasshoppers, and other pests, and at these times the *malmignatte* is over-abundant. It may be said in her favor that she preys on such vermin with avidity, rather than devoting her energy to biting human beings. Summing up the distribution of the dark and fearsome widow, she seems to be well known by reputation throughout the world, although her life, habits, and the exact character of her venom are known only to individuals of the scientific world.

Our American black widow is a beautiful spider, as spiders go, and is much like a "shoe button" in size and shape, although some specimens measure up to half an inch in length. The unique feature in the lady's makeup, however, is the crimson hour glass on the under side of the abdomen, from which she derives the appropriate name hour-glass spider. This, together with her shining, ebony-black body, is her outstanding identification mark. On different individuals there is a variation in shape, size, and coloration of this mark. Some specimens have a single dot, others two disconnected marks, of red, yellow, and sometimes both colors, on the ventral aspect. However, the red hour-glass design edged with a thin margin of yellow is the most constant. In immature and small spiders the red or yellow sometimes nearly covers the lower abdomen.

You are perhaps wondering by this time just what sort of man the husband, or widower in the case is. In brief, he is one of those "Mr. Black Widow" personalities, thrust into the background by the fame of his notorious spouse. His body is smaller than that of the cannibalistic "amazon" female, measuring not much over a quarter of an inch in length, and is of a lighter hue, with two or three white, reddish, or yellowish stripes running slantwise down the sides of the abdomen, and an uneven stripe of the same colors or darker down the center of the back, in addition to the markings of the female. The legs are generally banded with yellowish or reddish, and the palpae or feelers are bulbous near the tips. The species found in the south are the characteristic black, having a dark red stripe down the center of the back, with lines of the same color on the sides. In California the males I have observed have been lighter in color, with the whitish side stripes. Another, and seemingly more mature phase, is black, the back and side stripes a dirty white or grey. Altogether, variation in the male spiders is as general as in the so-called weaker sex, while in some instances immature males and females are indistinguishable. The fangs or nippers of the males are much smaller than those of the widows, but their poison sacs, or glands are fully as large. A scientist who has done much

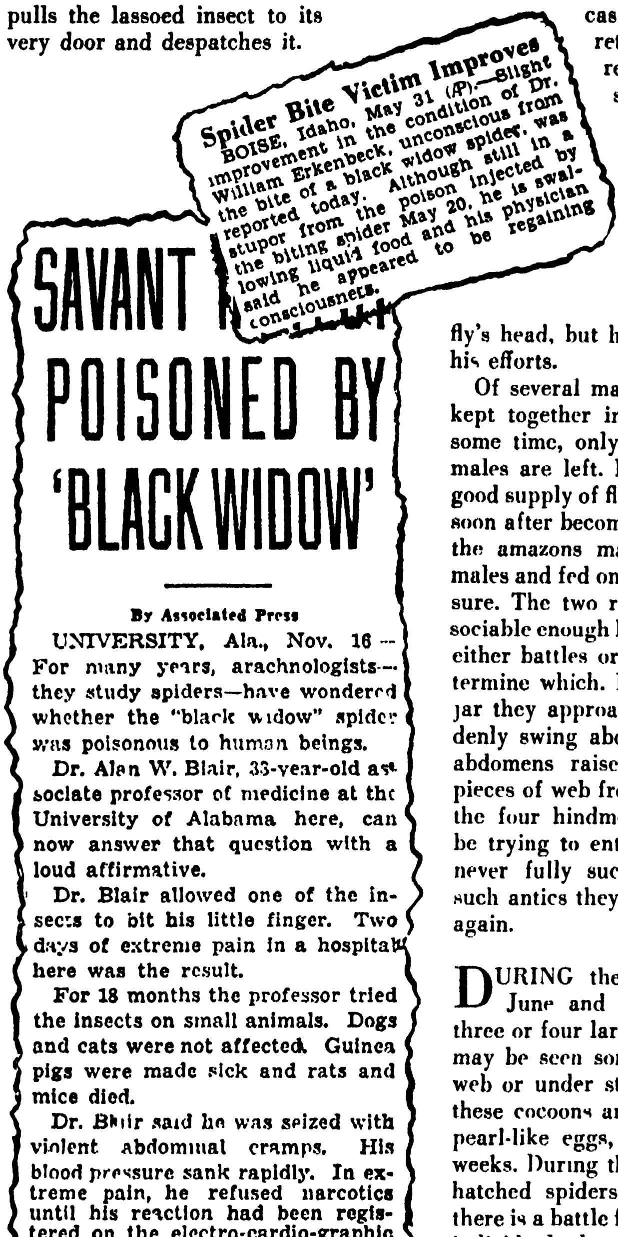
experimental work with Latrodectus declares that the male spider is harmless to man, as the fangs are not capable of piercing the skin.

There is another species of this genus, grey in color, called *Latrodectus geometricus*, which has been found in California, but is extremely rare.

You will find the black widow under stones, in holes in tree stumps or in the ground, about garages, out-buildings, and frame structures in particular. They are averse to light, and so build their web in dark places. You cannot mistake the web once you have seen it. The strands are very coarse, and are spun in a haphazard, criss-cross fashion, the main cables generally running up and down, anchored at the ends by a net-work of smaller lines. From these main strands thinner cables stretch at all angles, making the web altogether the most unbeautiful snare of all the spinners' webs. One of the most common places to find the web of Latrodectus is along the sides of the foundation of frame houses. The web is spun from the board siding to the ground, so that the spiders may make their lair up between the foundation and the boarding. At night they can be seen hanging in mid-air on their coarse strands, generally upside down, making the red marking on the abdomen plainly visible. If an empty web is discovered, the spider may sometimes be enticed from its hiding place by lightly shaking the cables with a stick or finger. Believing that an insect has become entangled, it will come out to investigate. However, it can't be fooled in this manner more than two or three times at the most.

It is a miracle to me that they can ensnare enough insects in their foolishly constructed web to provide food to keep them alive. I have on different occasions tried to lodge flies and other small insects in their trap without much success. The flies always drop through the wide openings between the strands. However, when some unfortunate insect does become trapped, it is interesting to watch the spider's methods of securing its prey. If the victim is too large or energetic to warrant a bold assault, the black widow will approach slowly, and warily wait for a chance to rush in, turn about, and throw a few strong loops of web around a wing or leg. When the victim's struggles become weaker the spider will advance again, and by perseverance will soon be able to give the insect a nip with its fangs. Immediately after the bite there is a pronounced lack of force in the movements of the spider's prey, followed shortly by its complete demise. Then Latrodectus cuts all lines holding the victim to the web proper, and carries it off to the den to devour at leisure.

Again, if the victim is small and more or less inoffensive, and has escaped from the web and is crawling away, our spider acquaintance will hurry down a silken strand until close above the insect, then turn quickly and with its long rearmost legs attach a line to its prey, returning immediately to take a stand near the entrance to the lair, where it pulls the lassoed insect to its very door and despatches it.



Spider Bite Victim Improves

BOISE, Idaho, May 31 (AP)—Slight improvement in the condition of Dr. William Erkenbeck, unconscious from the bite of a black widow spider, was reported today. Although still in a stupor from the poison injected by the biting spider May 20, he is swallowing liquid food and his physician said he appeared to be regaining consciousness.

SAVANT POISONED BY 'BLACK WIDOW'

By Associated Press

UNIVERSITY, Ala., Nov. 16—For many years, arachnologists—they study spiders—have wondered whether the "black widow" spider was poisonous to human beings.

Dr. Alan W. Blair, 33-year-old associate professor of medicine at the University of Alabama here, can now answer that question with a loud affirmative.

Dr. Blair allowed one of the insects to bit his little finger. Two days of extreme pain in a hospital here was the result.

For 18 months the professor tried the insects on small animals. Dogs and cats were not affected. Guinea pigs were made sick and rats and mice died.

Dr. Blair said he was seized with violent abdominal cramps. His blood pressure sank rapidly. In extreme pain, he refused narcotics until his reaction had been registered on the electro-cardio-graphic table at the hospital.

This ordeal over, Dr. Blair went to bed and spent two days in intense suffering, despite continued injections of opiates.

Today he was back at home, weak and pale, but able to eat again for the first time since the experiment.

Newspaper clippings. Medical journals also mention serious cases of bites which occurred in outhouses

The male spiders, being so much smaller in size, find the capture of food more difficult, although they display more courage in their attack than the females. I managed to introduce an extremely large and half dazed green fly into the web of a small male spider. It buzzed lustily, all but tearing the web apart. The spider quickly approached, but the commotion was such that he was nearly hurled from his position. He returned again and again, each time backing up as close as possible and throwing a line or two over the fly, securing it more firmly to the web. Occasionally he would make return trips up the web to repair and strengthen some section broken by the struggling fly. In the end he had completely subdued his victim and was enjoying a well-earned feast. This spider was in body no larger than the fly's head, but he had courage back of his efforts.

Of several males and females I have kept together in a large glass jar for some time, only two of the largest females are left. I provided them with a good supply of flies and small moths, but soon after becoming used to their prison the amazons made short work of the males and fed on them with evident pleasure. The two remaining females seem sociable enough but sometimes engage in either battles or play—it is hard to determine which. In crawling about their jar they approach each other and suddenly swing about, back to back, with abdomens raised high, and lash out pieces of web from their spinnerets with the four hindmost legs. They seem to be trying to entangle one another, but never fully succeed. After a time of such antics they go their separate ways again.

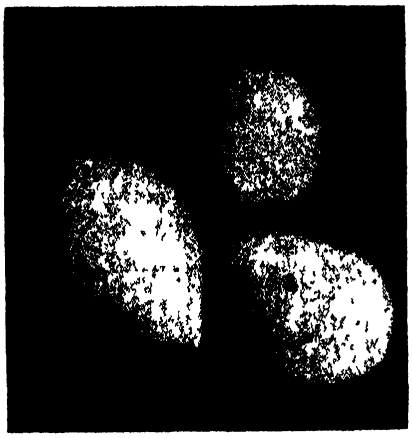
During the egg-laying season in June and July, the females spin three or four large white cocoons, which may be seen sometimes hanging in the web or under stones and old boxes. In these cocoons are some 200 to 300 tiny pearl-like eggs, which hatch in a few weeks. During the short time the newly hatched spiders spend in the cocoons there is a battle for survival, the stronger individuals devouring the weaker, until finally a hole is bitten in their round "incubator" and the young spiders crawl forth to face the world. They commence feeding then on any small insects or spiders that can be captured, the females becoming mature in some 60 days and the males attaining their growth more slowly. As far as I can ascertain, the old female spiders either die or disappear in nooks and crannies at the end of the warmer weather. The males seem harder to rear in captivity and they die in a short time, but it is reasonable to assume that their habits are similar to those of the widows.

The black widow would be insignificant—just another spider—if it were not for the venomous nature of her bite.

Her reputation and notoriety are based on that, and it is the main point for consideration. Cases of spider bite—or arachnidism, the medical term—are reported each year from the southern and southwestern states, and of varying degrees of seriousness. In 1927 in California there appeared to be an epidemic of bites of Latrodectus, and many cases were assigned to hospitals. In 1932 a California physician stated before the assembled College of Physicians that there were "hundreds, and probably thousands of cases of spider bite yearly in the United States. Nearly 400 cases of black widow poisoning were actually reported, 20 cases being seen in a Los Angeles hospital in the past year." He went on to say that "several death certificates were made out in California from this cause, and several others were reported in newspapers and personal communications." According all due respect to this physician, I am inclined to believe his statement a bit exaggerated. In many instances cases of "spider-bite," or black widow bite, are diagnosed on nothing more than circumstantial evidence, as the spider or insect accused of the biting is seldom seen, and if so it is not readily recognized by the general public. However, this California doctor made a statement in regard to the bite of black widow which is worth consideration: "Even though the mortality rate is low, the possibility of fatal termination cannot be disregarded."

THERE is little doubt that the bite of the black widow is much more serious than that of other arachnids, and depends in effects on both the condition of the spider and the person who is bitten. The venom, unlike that of the scorpions, tarantulas, centipedes, and others of this family, does not affect locally, but through the blood system it quickly affects the entire body. This rapid action of the venom likens it to that of the dreaded rattlesnake, since it acts as a haemolysine, destroying the red corpuscles of the blood and coagulating the fibrin. From questioning, observing the symptoms of those persons actually known to have been bitten by Latrodectus, and by careful experimentation, science and the medical world have pretty well established some sound facts.

If one is bitten by this spider, he will not long be left in doubt. The immediate effect of the bite is an exquisitely sharp pain at the point of contact between person and spider. In an actual experiment made by a nervy scientist in Arkansas a few years ago, he allowed himself to be bitten on the finger by a large female, with the following results: sharp pain at the seat of the bite, gradually extending up the arm and throughout the body. This condition grew worse and within about five hours he experienced difficulty in breathing and talking. He had previously made arrangements with his physician and was taken to a hospital, where the reactions could be observed and charted. A low temperature, between 99 degrees and 100 degrees, accompanied these symptoms, with aching pains through the entire body, especially in the chest and hips. This condition persisted for about three days, hot baths bringing the most relief. He states that it took much patience and pestering to induce the spider to bite and that, although the experience was not a pleasant one, the adventure was worth the experiment. Some time later, while studying the male Latrodectus, this same scientist tried to encourage one to bite him on the inner side of the small finger. All the response he obtained was a slight nibbling. The spider seemed unwilling or unable to make connections.



The cocoons of the black widow, enlarged approximately three times

A Russian scientist who in 1909 was an honorary curator of arachnology in an American museum, writes of this spider: ". . . one genus poisonous, that of Latrodectus, which has its representatives in all warm countries." He mentions the *malmignatte* of Italy, saying, "it is probable that the convulsions following the bite of this spider are attributed to the fable of the tarantula." In south Italy the famous dance, *tarantelle*, is supposed by legend to be the result of the bite of the tarantula. He goes on to say of Latrodectus: "The female is poisonous, the male harmless," and tells of the research work of Professor R. Kobert of Rostock, who extracted the venom from these spiders by means of a salt solution and injected it into the blood systems of animals. He found the extract from a single spider sufficient to kill 1000 cats. This would indicate extreme potent possibilities, but when we consider the chemical action undergone by the venom during its extraction, it might well have much more killing power afterward than in its natural state. This is in a way proved by some later experiments on rats. The spiders in this instance were American black widows and the injections were made by the spiders themselves. The rats immediately became groggy and showed signs of violent convulsions, but eventually recovered. It is possible that the spiders were low on venom, or that the fangs were not sufficiently embedded, but a second biting some time later showed the rats to be partially immune to the poison. We must also take into consideration that, although the effects of the bite of the European and Russian species of Latrodectus are considered similar, there may be some difference in the amount of potent quality of the venom, due to climatic conditions. Continued experimentation shows that the poison of Latrodectus is potent throughout the life of the spider, but it is reasonable to assume that in sickly or even healthy individuals there are times when the venom supply is low or weak and accordingly less potent in its effects.

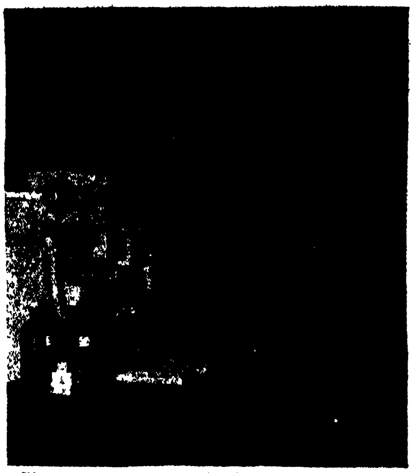
Modern methods for treating the sufferer of our black widow bite are not what they should be at the present time, as far as I can ascertain. From communications with one of the head physicians of one of the largest medical centers in California I find that no definite serum or treatment has been established. Of the many persons admitted to that hospital apparently suffering from the bite of Latrodectus, only a very few could positively be classed as black widow victims; these brought the spiders with them. Their symptoms varied slightly, but in all cases intense pain seemed to be the main factor. Poulticing, hot applications, hot baths, and a general systematic treatment were used, recovery commencing in about two days. These patients were asked to return to the hospital in a few days so that some of their blood might be taken to make anti-toxin for the next victim. This, I was told, was the only serum that had ever been used, and as actual cases of black widow bite were few, no regular supply could be kept on hand under the circumstances.

ANTI-TOXINS, or anti-venins for "rattle-snake" bite are now on the market at an unreasonably high price and are standard equipment in all hospitals, doctors' offices, and medical centers. There should likewise be serums for black widow bite. The venom of Latrodectus, if injected into the blood system in the quantity of that of the rattler, would be fatal in a much shorter time and, once bitten, it would be doubtful whether the victim could be saved by any treatment. Fortunately, however, Latrodectus has a limited amount of venom and is not aggressive toward the human race. Her nocturnal habits and her sluggish nature are points on our side and, with the exception of her venomous bite, she is a most interesting and beautiful spider.

Dark-Rooms

And Dark-Room Technique for the Advanced Amateur Photographer

By A. P. PECK

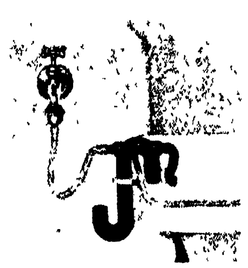


Photos courtesy Eastman Kodak Company

A corner of an amateur photographer's dark-room, showing rheostat for controlling the lighting circuit, and voltmeter mounted on the wall

WHEN the amateur photographer has advanced so far in his chosen hobby that he wants to do the whole job himself—developing, printing, enlarging, vignetting, and so on—a modern dark-room becomes a prime necessity. Whether this be installed in the basement or a spare room, its arrangement and equipment will have a vital bearing on the satisfaction to be derived from the hobby.

The sidewalls and ceilings of the modern dark-room should be painted, keeping in mind the light reflective properties of the finished surface. This is of particular importance when panchromatic and superspeed films and plates are used. These emulsions are sensitive to light of all colors, but if all light except that color to which the eye is most sensitive be excluded, there will be a minimum tendency to fog. If, therefore, the walls and ceiling of the dark-room be painted with a material which will reflect a maximum amount of blue-green light, and absorb all other colors as completely as possible, a happy medium will have been reached. Such a paint is now available under the name of Panchromatic Green, compounded especially for dark-room use.



A siphon which converts a large tray into an efficient photo-print washer

If an indirect light box, with a 25-watt bulb and a Wratten Series 3 safelight, is used in a dark-room painted with Panchromatic Green, the amateur will be perfectly safe in handling the fast emulsions of modern films with little or no danger of spoilage.

Another paint for dark-room use has been developed for protecting and preserving surfaces against corrosion and the ravages of chemical solutions. This is known as Kodacoat and dries with a non-reflecting black surface. It is almost entirely inactive when dry and may be used to water- and chemical-proof tanks and trays, to paint all kinds of dark-room equipment, for floors, and so on. The coating is tough, non-brittle, non-porous, and has a rubbery feeling.

An excellent surface for table tops and benches is battleship linoleum cemented in place and thoroughly waxed.

Fluctuations in line voltages often make exact duplications of exposures virtually impossible. If, however, a rheostat is included in the printing lamp circuit, and a voltmeter connected across the lamp, the voltage may be adjusted to a point somewhat below normal—say 105 volts—and maintained at that value by the rheostat.

In making up stock solutions for photographic work, only the best and purest chemicals should be used. These must be kept in containers which are carefully labelled, stored in a definite place, and securely closed when not in use. Accurate scales should always be used in weighing batches of chemicals and the solution should always be mixed exactly according to directions. The order of mixing should be faithfully followed when dissolving the chemicals, and finally water should be added to bring the solution up to the required volume.

The amateur will find it good practice to filter all solutions before use, to remove any particles of foreign matter which might settle on films or paper and cause spots. A simple filter may consist of several layers of muslin in a glass funnel. If there is very much organic matter in the water supply, it is advisable to install a filter on the tap. The very best results are to be had when distilled water is used for mixing solutions.

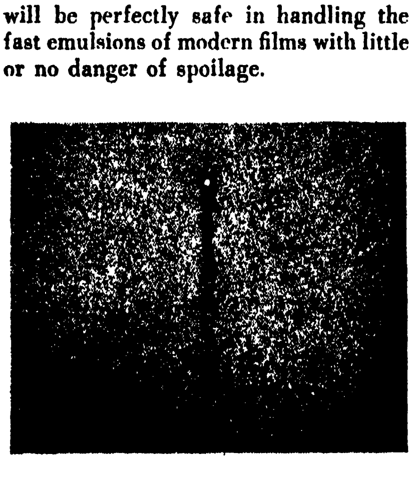
Thorough washing of prints is an absolute necessity for good work, but is often slighted. A device which insures proper washing is illustrated on this page. It is a siphon which may be used with any large tray and which introduces fresh water at the top of the tray and siphons out the chemically laden water from the bottom.

Most markings and stains occasionally found on films after developing and fixing may be avoided by following these three simple rules: (1) Maintain all solutions as near a temperature of 65 to 70 degrees, Fahrenheit, as possible. (2) Discard a solution as soon as it shows signs of becoming exhausted. (3) Agitate all materials when first immersing and at intervals during treatment.

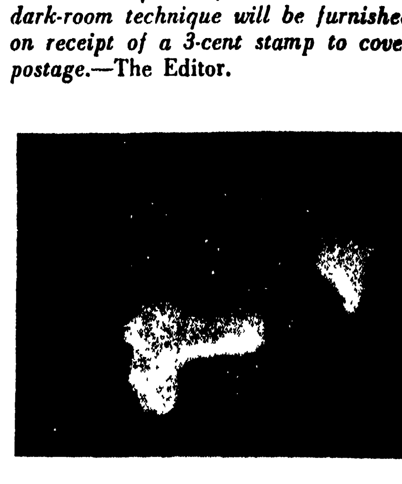
The film spot shown in the illustration in the lower left-hand corner of this page was caused by a bubble of air trapped at the film surface, and could have been avoided by observance of rule 3. The water spots shown below could have been prevented by wiping the film carefully with chamois, and drying without excessive heat.

●

References to other literature on the subjects of dark-rooms and dark-room technique will be furnished on receipt of a 3-cent stamp to cover postage.—The Editor.



Right: An air bubble trapped on the surface of the film caused this spot, _Left:_ Water spots on drying films are often caused by excess heat



THE FOLLY OF

By IGNATIUS W. COX, S.J., Ph.D.
Professor of Ethics at Fordham University

NO sensible man can be opposed to the aim of eugenics, the health and happiness of future generations. The attempt, however, to attain this end by a means unjustifiable on scientific or moral grounds, and hence, fundamentally on legal grounds—namely, by human sterilization—will meet the opposition of those who give the subject profound consideration. "Biology has become popular," writes H. S. Jennings, of Johns Hopkins University, in his "Biological Basis of Human Nature," "but the enthusiasm of the biologist at this Utopian situation is dampened by doubts and worries as to the soundness of some of the maxims that are circulated in the name of biology. . . . The situation is one that gives wide opportunities to the cocksure and uncritical, to those who are not troubled with doubts as to whether their science has solved the problems of humanity."

Advocates of sterilization seek the "elimination of the undesirable elements in society, along with the burden so long imposed upon us by their multiplication and their helplessness."[1] But how determine what are the "undesirable elements"? It is the way with some eugenists to judge *eugenic value* by *social standing, economic competency*, and the amount of *formal education* received. Social standing, however, is not virtue; economic competency may imply crime; and formal education has cultivated at times many shady acquaintances.

SOME eugenists are prone to confuse education with intelligence; cleanliness with good living; ignorance with vice; and mental deficiency with the slums. Raymond Pearl, Director of the Institute for Biological Research of Johns Hopkins University, concludes an article in the *Quarterly Review of Biology*[2] on "Differential Fertility" with these words: "The present paper is intended, in part, to show that the eugenic condemnation of whole social or economic classes, either directly or inferentially by the contention that only certain classes such as college graduates are eugenically desirable, is unwarranted by anything now known."

But apart from this there are certainly unfortunate individuals, both in the higher and lower classes, suffering from deficiencies physical and mental. They may be divided approximately into six groups: (1) the infectious or contagious, such as tuberculars, syphilitics, and lepers; (2) the degenerates, such as sadists and drug habitués; (3) the delinquents, such as waywards and criminals; (4) the dependents, such as the deaf, the deformed, the blind; (5) the mentally diseased; (6) the mental deficients, such as morons and idiots.[3]

Now what is the scientific possibility of eliminating such unfortunates from the human stock by sterilization? First of all we must be able to determine scientifically whether the deficient characteristic is acquired or inherited. It is generally accepted by biologists that acquired characteristics are not transmissible by heredity. But the first four classes represent those whose deficiencies are admitted, for the most part, to be acquired characteristics. Many of these deficiencies can be remedied by institutionalization, by therapeutics, and by education. With regard to crime, C. B. Davenport, Director of the Department of Genetics, Carnegie Institution of Washington, writes under the caption, "Crime, Heredity and Environment," that "Prompt and painful punishment is the best panacea for crime."[4]

THIS leaves for our consideration the last two classes, those mentally diseased and mentally deficient. With regard to mental disease, Myerson[5], a great authority, declares that "only a few of the major mental diseases . . . are hereditary or, to use a more exact term, familial. . . . Just two important psychoses run in families. . . . These are dementia praecox and manic depressive psychosis. The latter is by far the more likely to appear in several members of a generation and to appear in more than one generation. But many cases of even these diseases appear as *isolated* characteristics of one individual and cannot be linked up with *mental disease* of the *family*, or appear without any *hereditary* linking up which is worthy of the name. . . . Further, very few cases are reported where mental disease of this type ran for many generations. A few cases of three-generation disease are recorded, only one or two where four generations were mentally sick. It appears that mental disease, like physical disease, either *destroys the stock which it attacks, or there is final recovery*."

"The causes of mental diseases are still an unsolved mystery," declares Landman.[6] Even Paul Popenoe, an advocate of sterilization, admits that the prolificity of the mentally diseased is low[7] and that the marriage rate of such of both sexes is below that of the general population.[8] Besides, many of the mentally diseased require institutional care and in that case there is no meaning to sterilization.

It is the last class, including all kinds of feeble-mindedness, which gives particular concern to the pessimistic eugenist, and against this class the weapon of sterilization is particularly aimed. But we know little, if any more, about the transmission of feeble-mindedness through heredity than we do of the heredity of mental disease: "Much of feeble-mindedness is environmental in origin," says Myerson[9], "much is hereditary, but most is of unknown origin, and may represent the inexplainable, downward movement of intelligence, just as genius represents its inexplainable upward movement."

"BOOKS have been written on the menace of the feeble-minded," remarks the same author. "It is alleged that they are the criminals and the prostitutes of the land and their great prolificity makes them the potential population of the world, if one theory or another were not done to them. It is 'proved' that their royal families, the Jukes, Kallikaks, Ishmaels, Nams, are the chief reasons for the high cost of living, and normal folk slave to build prisons, feeble-minded schools, hospitals, courts, poor farms, and the like for these people and their descendants. Now the Jukes, the Kallikaks, and so on, are bad enough, but it has *not been proved* that they are *really* feeble-minded, and it is not true that, even if they are feeble-minded, they are typical of the bulk of cases of feeble-mindedness. . . . Such families as the Jukes, Kallikaks, Nams, tribes of Ishmaels, are not representative of feeble-mindedness, if we may judge by our studies of some 860 families in Massachusetts. . . . We found nothing like the prostitution, crime, and general unfitness recorded in these families. Elsewhere, I have criticized the totally indiscriminate way in which *low*

Human Sterilization

cultural level has been called *feeble-mindedness* in the case of these families. . . . Personally I find it hard to evaluate individuals after a long acquaintance with mental and physical disease."[10]

With regard to the so-called prolificity of feeble-mindedness we read in the British Governmental Report to the Departmental Committee on Sterilization[11], 1933: "The supposed abnormal fertility of defectives is, in our view, largely mythical and results from the accident that from time to time distressing exceptions to the general rule find their way into the courts and are introduced in the press." Besides, as Landman writes[12], "In a study of 605 case histories of the feeble-minded in the same state (California) 34 percent of the males and 28 percent of the females were still institutionalized." Sterilization for these simply does not make sense, unless there is claimed for it therapeutic value, for which there is no proof. The fear, therefore, that the mentally deficient are giving a wholly disproportionate contribution to the community in a differential birth rate favoring feeble-mindedness, simply does not stand up in the light of any known scientific facts.

BUT let us assume that we know more about the cause of mental disease and mental deficiency than we actually do. Let us pass over for a moment the statement of Landman[13] that, "These serious criticisms of the present status of eugenics show its great need for more science and less speculation. . . . Human sterilization, as a social program, requires more scientific evidence." Let us transmit for the moment what S. J. Holmes, himself in favor of sterilization, admits: "In reading the productions of my fellow eugenists I not infrequently meet with statements which cause me to squirm. It must be confessed that much of the literature on eugenics, in the present infancy of this science, is characterized by ***hasty generalization*** and ***uncritical overstatement.***"[14] Suppose we knew just what deficient human characteristics are inherited and what are acquired. To eliminate, to any large extent, the undesirable characteristics by sterilization, we would have to know more about the method by which such defects are transmitted by heredity.

Some biologists accept the gene theory as a means of explaining the hereditary transmission of *human characteristics*. The gene theory is applied to human beings only by analogy, an inconclusive application. Jennings warns us against this type of argument in his list of biological fallacies of which the first reads: "The fallacy of non-experimental judgments in matters of heredity and development."[15] Hence an attempt has been made to support this theory by an appeal to intelligence tests and family trees. Of course this is not a scientifically biological procedure. Besides, intelligence tests are uncertain and frequently based on different methods, while family trees do not yield the same results to different investigators.

In the light of the gene theory, what can we expect of sterilization as a means of eliminating deficient characteristics and specifically feeble-mindedness, the chief concern of the advocates of sterilization? On this theory, if two good genes or one good and one deficient gene were paired in the same germ cell the effect would be normality in the resultant individual. Now there are very many men and women who carry one of these deficient genes which tends to produce feeble-mindedness. Only when this one deficient gene from the male unites with a like deficient gene from the female in the same pair would the offspring be deficient. Those who have one deficient gene are called carriers and are themselves normal. It is a ***guess*** that there are about 10,000,000 carriers in the United States; we have no scientific knowledge for the detection of carriers.

THE fallacy that inferior individuals must have come from inferior ancestors is well illustrated by the well-known case of Elizabeth Tuthill Edwards, a colonial dame. Speaking of her, Professor H. H. Newman of the University of Chicago says in his book, "Evolution, Genetics and Eugenics": "She was divorced from her husband on the ground of adultery and gross immorality. The evil trait was in the blood, for one of her sisters murdered her own son and a brother murdered his own sister. Richard Edwards (the first husband of Elizabeth Tuthill) married again after his divorce and had five sons and one daughter, but none of their numerous progeny rose above mediocrity." Harvey Wickham, in "The Misbehaviorists," in speaking of the same Elizabeth Tuthill Edwards, says: "So if the eugenists had been in control 300 years ago . . . Elizabeth Tuthill would have been refused a marriage license even had she escaped a worse fate. Crime and insanity seemed to have marked her for their own. And yet it was from her . . . that descended Timothy Edwards, one of the founders of Yale University, 12 college presidents, 265 college graduates, 65 college professors, 60 physicians, 100 clergymen, 75 army officers, 60 prominent authors, 100 lawyers, 30 judges, 80 public officers—state governors, city mayors and state officials—three congressmen, two United States senators and one vice-president of the United States, Aaron Burr, Mrs. Eli Whitney, Winston Churchill, Edith Carow, widow of Theodore Roosevelt, the Marchioness of Donegal, Morrison R. Waite, former Chief Justice of the United States, George Vincent, head of the Rockefeller Foundation, Grover Cleveland and U. S. Grant."

Wickham quotes as his authority for these statements Horatio Haskett Newman of the University of Chicago and Albert E. Wiggam, author of "The Fruit of the Family Tree."

—The Author

"IT has been computed that if the proportion of feeble-minded in the population is one per thousand, to decrease that proportion to one per ten thousand will require about 68 generations, or two to three thousand years, if it is done merely by stopping the propagation of feeble-minded individuals."[16] The reason is that feeble-mindedness, on this theory, would still be largely propagated by normal carriers of the defective genes. Jennings thus concludes: "For more effective action than is now possible for improving the race through eugenic measures, and particularly for getting rid of marked single gene defects, two great advances in knowledge and practice are required."[17] The first of these is to discover means of identifying normal carriers of defective genes. The second is to know more about what human troubles are due to single-pair gene defects. "The great difficulty about this is that bad living conditions often produce the same kind of results that bad genes do. Persons may become idle and worthless, insane or criminal or tubercular—either through bad genes or bad living conditions, or through a combination of both."[18]

But suppose these favorable discoveries were made, still I do not think the problem would be solved for the steril-

izers. And this is a matter which nowhere have I found adequately discussed. How did the deficient genes originate in the race? Are human beings producing within their own vital organisms *new* deficient genes which they pass on to their progeny? Certainly biology discusses in lower forms of life the mutation of genes by X ray and perhaps by radioactivity from the earth. Are there in man other circumstances which may mutate the genes, from the combination of which the inherent constitution of the individual is supposed to arise? Is there a possibility of the mutation of human genes by the emotional and mental states of parents? To these questions biology, I think, has no certain answer one way or the other. If *new* deficient genes are being produced as rapidly as the *old* ones can be removed by sterilization, then the sterilizers are similar to a group of men who are trying to drain a lake when as much water is flowing into it as is being drained off.

HERE, I would call attention to two other fallacies listed by Jennings[19]: "The fallacy that preventing the breeding of hereditary defectives will largely or entirely get rid of such defectives in later generations" and the fallacy "that superior individuals must have come from superior parents; and that this will continue to happen." Raymond Pearl sums all this up in the "Present Status of Eugenics"[20]: "In preaching as they do, that 'like produces like,' and that therefore superior people will necessarily have superior children and inferior people inferior children, the orthodox eugenists are going contrary to the best established facts of genetical science, and are, in the long run, doing their cause harm. . . ." "But, on the record, something of the order of 95 percent of the greatest philosophers, poets and scientific men that have actually appeared during the history of our race *would never have been born*, because the people who were in fact their parents would not have been allowed to breed under such a régime." (Meaning "eugenic" régime—*I.W.C.*) Raymond Pearl has some strong things to say[21] about propagandists for eugenics: "Leaving aside all discussion of what might be called the broad humanitarian aspects of these eugenic theses . . . I wish to submit that they are all based upon and derive their entire meaning from what is now known to be a profound fallacy."

ADEQUATE discussion of the ethical side of sterilization is here impossible for want of space. It is susceptible of positive, rational proof that sterilization is unethical and immoral. If man is not obliged by moral law to do good and avoid evil in the use of his freedom, then there is no such thing as morality; and man, on that hypothesis, has a right to abuse his own faculties and those of others; to lie, to steal, to murder, to the limit of his physical possibility. The moral law obliges man to use his faculties in accordance with the finality written in their nature. To use a faculty and to positively frustrate its finality is to *use* that faculty to *abuse* it. That is why lying is wrong. That is why voluntary sterilization is wrong. To say that sterilization leaves the sex faculty unimpaired is to utter an absurdity. The sex faculty is changed by sterilization as radically as the powers of speech would be changed by an operation which permitted the emission of sounds but prevented the finality of speech, namely, purposeful utterance. Sterilization is a mechanism to allow use of the sex faculty, while frustrating positively the primary purpose or finality given to it by Supreme Intelligence. One may legitimately refrain from the use of a faculty, as of speech or of sex. It is quite another thing to use such faculties and in their use to provide positive means for the frustration of their primary purpose, as happens in the case of lying and sterilization.

THIS is the last of four articles on human sterilization. The others appeared in the June, July, and September numbers.—*Editor.*

JUST as it is wrong to submit to voluntary sterilization, so it is equally wrong for the state to command sterilization. Such a command implies the immoral doctrine of the absolute state, that man is for the state and not the state for man. Hence the decision of Justice Holmes in the now famous Carrie Buck case is indefensible on ethical and moral grounds. Of course that decision is not binding in conscience. The state for legitimate reasons may prevent the *use* of an individual right, by segregation, for instance; but this does not and cannot imply the right of the state to *destroy by mutilation* the finality of the faculty which is the *basis* of the individual's right.

And so the "case for sterilization" breaks down all along the line. It simply does not make sense. Emotion has been substituted for reason, and wishful thinking for scientific procedure. The case for sterilization breaks down in its attempted classification as to what are the best eugenic breeds and what not. It breaks down in its attempted classification of hereditary as completely divorced from environmental characteristics. It breaks down in its attempt to show that sterilization would make any appreciable difference in the number of "undesirables" in the future. And hence its economic argument breaks down. Since there is no evidence that man will be able to reduce by sterilization the number of unfortunates in the future, the savings indicated by that method are wholly problematical. As a matter of fact, sterilization stations, birth control clinics, and parole officers are all included in the eugenic program, with expenses actually increased. And add to this that a great number of those actually sterilized would still require institutionalization.

Let us not forget the fact that there are certain lines of procedure which are legitimate and effective as eugenic measures. There are two especially which will make for healthier and happier living for ourselves and posterity. These are the elimination of war and social injustice. Sir George Peel states that 70 percent of the budgets of five great powers is employed either in paying for past wars or preparing for future ones. War is disgenic. It brings with it an ever-widening trail of death, disease, insanity, neuroses, economic and financial confusion. Social injustice is, in large measure, responsible for our slums, for disease, for helplessness in human life, for despondency and consequent neuroses. In this country it is possible to produce enough that all may live well, if the wealth we produce is properly distributed through a cultural wage, and not allowed to concentrate in the hands of a few. And notice this: that war and social injustice are too often the result of the leadership of those who are supposed to be of the best eugenic breed: the educated, those of social standing and of economic competency. To pass over war and social injustice in the hope of eradicating human ills by sterilization may be good propaganda; certainly it is bad eugenics.

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1 "The Case for Sterilization," by Leon F. Whitney, page 8
2 March, 1927, Vol. II, page 117.
3 "Human Sterilization," J. H. Landman, page 128.
4 *Journal of Heredity*, Vol. 19, 1928, pages 307-313.
5 "The Psychology of Mental Disorders," A. Myerson, pages 116-117.
6 "Human Sterilization," J. H. Landman, page 146.
7 *Journal of Heredity*, 1928, pages 73-81.
8 "Marriage Rate of the Psychotic," in *Journal of Nervous and Mental Diseases*, Vol. 68, 1928, pages 17-27.
9 "The Psychology of Mental Disorders," A Myerson, page 123.
10 The same, pages 121-123.
11 Page 18.
12 *Scientific American*, June, 1934.
13 "Human Sterilization," J. H. Landman, page 197.
14 "The Eugenic Predicament," S. J. Holmes, page 124.
15 "The Biological Basis of Human Nature," H. S. Jennings, page 206.
16 The same, page 242.
17 The same, page 249.
18 The same, page 250.
19 The same, page 218.
20 "The Present Status of Eugenics," page 20.
21 The same, page 10.

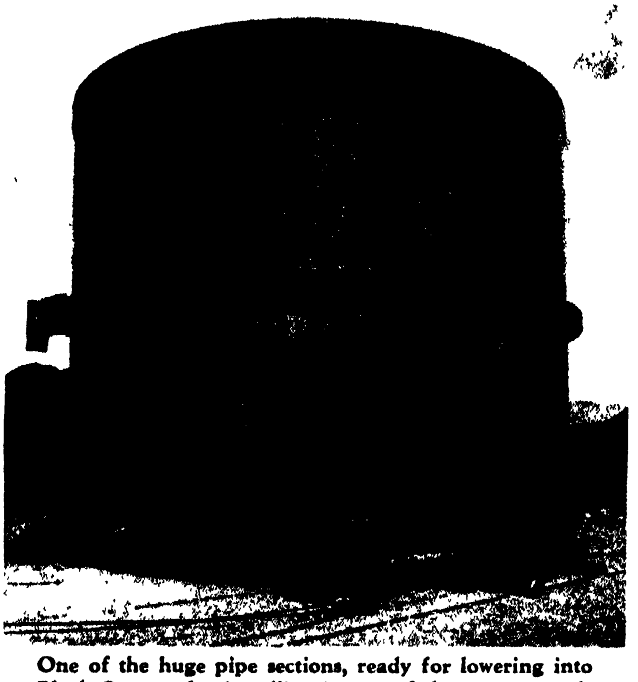
Steel Arteries for Boulder Dam

By R. G. SKERRETT

WHEN the last of the 7,000,000 tons of concrete composing Boulder Dam has been placed and that titanic barrier has bound together the two walls of Black Canyon, a reservoir will have been formed reaching upstream for 115 miles and capable of impounding 30,500,000 acre-feet of the Colorado River's flow. The completion of that monolithic wedge will rob the flood periods of that great stream of their destructive force and confine those otherwise tumultuous waters so that they cannot sweep onward unchecked to their ultimate goal, the Pacific Ocean. But the Government engineers will then have achieved only part of their threefold purpose.

The public generally believes Boulder Dam to be designed merely to curb the Colorado River. This is a misconception of the undertaking as a whole. The flow of the river varies greatly in volume from season to season. There are periods when less than 3000 cubic feet of water flows through the canyon where the dam is now rising; then suddenly, when melting snows and torrential rains in the distant mountains drain into the tributary streams, the Colorado may flow at a rate of fully 300,000 second-feet! Large as is the total annual volume of flow, these great differences mean that dependent husbandmen on the irrigated areas contiguous to the river in Arizona and California—especially in the Imperial Valley of the latter state—may still be desperately hard put to it because there is not sufficient water immediately available to satisfy the needs of their growing crops. On the other hand, when the river is on a flood rampage, they may have to battle day in and day out for weeks to keep the river from breaking through defensive earthworks and inundating their farms, their homes, and other buildings.

MANIFESTLY, the Boulder Dam project must serve to impound flood waters that would otherwise go to waste; and then it must make it possible to release those arrested waters into the river below the dam so that a sufficient volume shall continue onward to meet all the requirements of people now dependent upon this stream, as well as those that shall draw from the Colorado in the future. This provision calls for flow regulation, day in and day out the year 'round, that will insure a more even flow in the river below Black Canyon than has been the case with the Colorado uncurbed. This regulation is as vital to the successful service of the project as halting the seaward surge of floods.



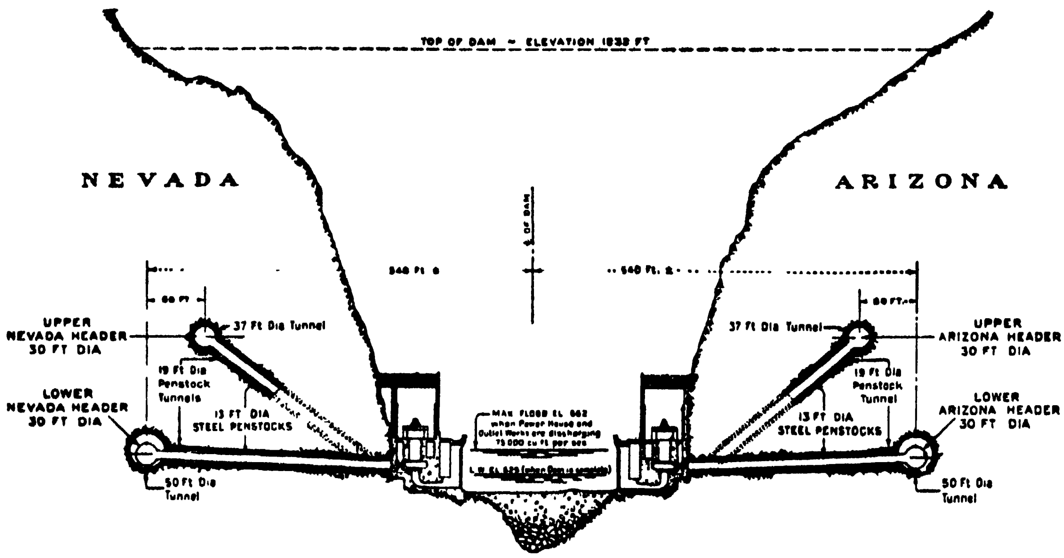
One of the huge pipe sections, ready for lowering into Black Canyon for installing in one of the great tunnels

The generation of power is incidental to the broad scheme, but it provides a way to reimburse the Government so that the undertaking will pay for itself without levying upon the nation's taxpayers. When fully equipped, the Boulder Dam power plant will be capable of generating a maximum of 1,835,000 electric horsepower; the current, to be sold at an extremely low price, will refund the first cost plus interest, provide funds for maintenance, and insure a handsome surplus within 50 years. This cheap electricity will be a boon to industrial and domestic consumers located within the far-flung range of distribution, and the energy will also be utilized to help pump water from the Colorado over intervening mountains on the 241-mile journey from the river to the terminal reservoir that is to supply Los Angeles and 12 associate communities that will thus obtain twice as much water as they now consume. This abundance will take care of their water needs for decades to come.

Before describing the extraordinary system by which water held in restraint by Boulder Dam will be returned to the course of the river under continual control, it may be well to sketch the needs of the people living in the Imperial Valley as well as those occupying the area embraced within the Metropolitan Water District of Southern California. At the present time, about 75,000 people resident in the Imperial Valley are directly or indirectly benefiting from the 500,000 acres of irrigated lands that are now under cultivation and which produce crops having an average annual value of 100,000,000 dollars. Another half million acres of irrigable lands in the Imperial Valley can be made productive, and thus double the marketable output and the number of people that can be gainfully employed there.

TO this end, the All-American Canal, which is to trace its course throughout above neighboring Mexico, will take water from the Colorado River and deliver it to both the Imperial Valley and the Coachella Valley. The main section of this waterway will be 80 miles long and is to have a maximum capacity of 15,000 second-feet. From that artery there will be a branch canal, 130 miles long, that will extend into the Coachella Valley. Work on the All-American Canal is to start shortly, and that great ditch will relieve American farmers from dependence upon a canal that now leads the water to them after first flowing through a nearby section of Mexico. The construction of the Colorado River Aqueduct is going forward rapidly, and is being built large enough to deliver at the terminal reservoir in southern California a maximum of one billion gallons a day.

Through a unique and stupendous arterial system the regulated flow of the Colorado will move to the big water wheels in the power house at Boulder Dam or be returned directly to the

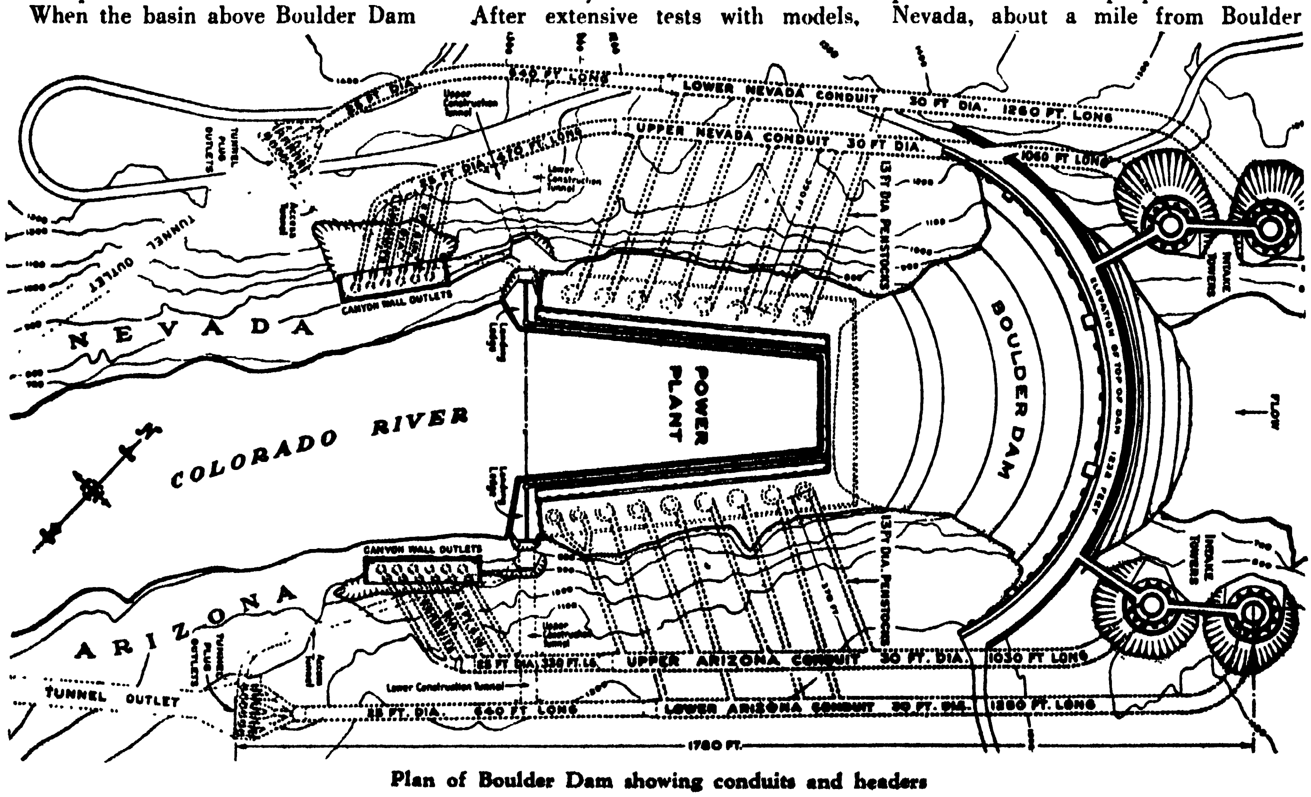


Schematic diagram showing a cross-section of Black Canyon at the power house. Steel headers are shown in their tunnels. Fifty-foot spillway tunnels (not shown) are off to left and right of picture

course of the river below the dam through four groups of immense balanced needle valves. In any case, and under all conditions, the volume of water that may be used to generate electrical energy, or return to the stream through the great outlet valves, will be sufficient at all times to insure an ample supply for our own people and for our Mexican neighbors who rely upon the Colorado for water. The fabrication and the installing of the steel conduits of this extraordinary regulatory system are the outcome of much intensive and unusual scientific research. One by one, difficulties have been overcome, puzzles have been solved, and technical aids devised that render possible the rapid prosecution of the task and the maintenance of exacting standards of workmanship.

When the basin above Boulder Dam is filled, the level of the lake will be 590 feet higher than the turbine inlets; at the lowest operating level, the water will be 420 feet above the power wheels. The average working head will be 520 feet, and the static pressure at that stage will be about 225 pounds per square inch. Water at that pressure would be sure to seek out even the smallest avenue of escape and, perhaps, quickly enlarge such a channel. The Bureau of Reclamation, therefore, decided not to subject the walls of rock-driven tunnels to such high pressures, even should the tunnels be heavily lined with concrete, because they feared that the enveloping rock in places might yield, the lining crack, and the water escape and damage either the dam itself or some of the associate works. It was necessary to find some other system of distribution.

After extensive tests with models, large and small, and much other research of an exceptional character, the technicians recommended the use of steel arteries to carry the water, and that the sturdy piping be housed in rock-driven tunnels of sufficiently greater diameter than the conduits to permit the exterior of all the piping to be inspected at regular intervals. The largest of these conduits have an inside diameter of 30 feet and a wall thickness of 2¾ inches. The lesser of the pipe sections are 8½ feet in diameter, and their walls are formed of steel plates ⅝ of an inch thick. In its entirety, this unprecedented system will be made up of 14,500 linear feet of piping fabricated from 45,000 tons of steel plating. Since May, 1933, the multiple sections have been under construction in a big plant erected for the purpose at Bechtel, Nevada, about a mile from Boulder



Plan of Boulder Dam showing conduits and headers

Dam. These sections are being placed in their designated tunnels, and the first of the great 30-foot sections have recently been installed at the bases of the four monumental intake towers. That accomplishment represents a truly climactic stage in this part of the Boulder Dam project.

The contract for the conduits was awarded to The Babcock and Wilcox Company. For the contract sum of approximately 11,000,000 dollars that company undertook to fabricate near Boulder Dam and to install in the several rock-driven tunnels conduits having the following principal characteristics:

Length, ft.	*Diameter, ft.*	*Plate Thickness, in.*
4700	30	$1\frac{11}{16}$–$2\frac{3}{4}$
1900	25	$1\frac{5}{8}$–$2\frac{5}{16}$
5600	13	$\frac{15}{16}$ $1\frac{5}{16}$
2300	$8\frac{1}{2}$	$\frac{5}{8}$–$\frac{7}{8}$

ALL plates are bent cold by a powerful set of vertical rolls; and the edges of the plates are made ready for joining by electric welding on a planer that has a bed fully 40 feet long. Each erection-section of 30-foot pipe—a section being 24 feet long—is composed of six plates, 12 feet wide and about 32 feet long. One such section, when ready for installing, weighs approximately 140 tons. Two of these heavy plates weigh 46 tons and constitute a carload when in transit from the steel mill in distant Indiana.

All seams of every erection-section are fusion welded; the bonding seal is deposited by an automatic welding machine that represents years of development. The intense heat of the electric arc fuses simultaneously the edges of the plates to be joined as well as the welding metal that binds them together, and the welding metal is deposited in successive layers until the groove between the plate edges is filled. By forming the mass of the weld progressively, the underlying layers are annealed by the heat of the succeeding layers, and, finally, a weld is produced that is composed of fine-grained and very strong metal. The welding metal is in the form of rods or electrodes which are coated with a material that, in fusing, temporarily spreads a sheltering film of slag over the molten metal. In this way, the oxygen and nitrogen of the atmosphere are excluded from the still fluid steel, which might be impaired if it were exposed to either of those gases.

Notwithstanding the precision and uniform operation of the welding machine, each inch of every weld is explored with the aid of extremely powerful X-ray apparatus, and the resulting radiographs are examined by experts to detect any possible deep-seated imperfections. The faulty area of a weld, thus disclosed, is promptly cut out, the weld reformed, and then X rayed to make sure of its soundness. Before the job is completed no less than 400,000 feet of X-ray films will be used!

After each pipe section is completed in the shop, it is transferred to a furnace where it is held at a stress-relieving temperature that varies with the thickness of the pipe walls, and then allowed to cool gradually. This dissipates any stresses that may have been set up in the section during welding. Test pieces are examined after the stress-relieving treatment to make sure that the conduit section meets the specifications in every particular.

The sections are moved by a large trailer from the fabricating plant to the rim of Black Canyon. The trailer is about 37 feet long and 22 feet wide, and is supported on eight axles on which are 16 wheels fitted with solid rubber tires. Upon reaching the rim of the canyon, the sections are picked up and transported to one or the other side of the canyon by the permanent cableway that spans the gorge and is strong enough to handle unit loads of 150 tons. The cableway lowers each section to one of four landing ledges hundreds of feet below. There are two landing ledges on each side of the canyon, and each ledge is at the portal of a construction tunnel driven at right angles into the canyon wall to meet one of the main tunnels, also at right angles, in which conduits are to be placed.

To transfer the pipe sections from a landing ledge, there are double-deck trucks, each mounted on its own wheels, and the upper truck set sidewise on the lower truck. The upper truck bears the pipe section, which has its longitudinal axis at right angles to the lower or main truck. When this duplex vehicle reaches the intersecting main tunnel, the upper truck, with the pipe section, is pulled off the lower truck and on to tracks in the main tunnel and drawn thence to the required position for joining the pipe length with the lengths that have preceded it.

The various sections are united by special heavy rivets. In the final assembling of the conduits the work will be completed by riveting unriveted joints spaced at intervals of several hundred feet, and this work will be done when the temperature in the tunnel is lower than the lowest average temperature of the water that will flow through the conduits. Should this work have to be done during the hot months, the tunnels will be chilled by mechanical refrigeration. Thereafter, the conduits will have a tendency to expand and not to contract by reason of the temperature of the water within them, and this expansion will automatically increase the compression at the pipe joints and make them that much more watertight.

The man under the large section gives an idea of sizes

The contractor is allowed five and a half years in which to finish the fabricating of all the pipe and to install those conduits. When completed, these headers and penstocks will be without a comparable parallel in modern engineering.

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An article in our September issue described the aqueduct for supplying Colorado River water to Los Angeles; another article, to be published soon, will discuss other engineering details of this project.—The Editor.

AMERICA MUST BE SELF-CONTAINED

By JAMES W. GERARD

THE schoolroom and the balance sheet—these are the two most vital factors in America's choice of an economic policy. We must watch lest the red ink on our balance sheet grow into a tide that will swamp the happiness and welfare of future citizens now in the classroom. We must devise an economic policy which will assure these future citizens in the classroom the rights that have been the heritage of all American citizens—life, liberty, and the pursuit of happiness.

But how shall we do this? Only by choosing an economic policy in accordance with present day facts. Such a policy the Committee for America Self-Contained is advocating in urging a policy of economic self-containment.

The whaling industry is dead. And international trade, as we have always understood it, is dying the same stubborn, lingering death. Markets are vanishing. Ports are closing to trade. No longer are the products of international trade indispensable. They are being made at home, or they are being displaced by some other natural or synthetic product. Nations are throwing up tariff barriers and fortifying themselves with quota systems. They are applying science and are living more and more on their own resources and products.

FOR example, Mexican manufactures and tariffs have cut down the American market there for shoes. Flashlight batteries and cigarettes are produced in Yunnan Province in South China more cheaply than the imported products. The saltpeter industry in Chile is being crippled by the preparation of synthetic nitrates in the United States and other major countries.

Yet, this is but one reason why we must be self-contained. Out of the growth of science has come another development which makes it necessary to revise our old ideas of world trade. Everyone agrees that, as a manufacturing nation, the United States is a leader. But a great danger is inherent in this very strength.

Modern methods of mass production,

AT this crucial stage of recovery from years of depression, when every proposal for bringing back prosperous times is being assiduously studied and some are being experimented with, it ill behooves us to cast aside any possibility without a hearing. The future is still too uncertain for us to be sure that any one plan will operate to solve all our problems or will fail entirely.

For years *Scientific American* has concerned itself with the problem of economic nationalism in articles and editorials. Having nothing to do, *per se*, with international politics—though it has been called a war-breeder—this problem revolves around farm and labor profits, agriculture and industry. It is vital to the nation's welfare and as such has held the attention of scientist and layman, of economist and politician.

In the accompanying article, which we asked Mr. Gerard to write, there are presented some of the reasons advanced by proponents of "controlled economic nationalism" to explain their stand. You may or may not agree with them. We shall remain editorially neutral, and will, therefore, present the other side in a near future issue in an article by Raymond B. Fosdick, noted New York lawyer, who is well known for the many important public posts he has held. —*The Editor*.

which have been largely originated and developed in this country, have been evolved always with a view to operating without highly skilled labor or an undue amount of individual planning and preparation. Standardization, interchangeability, and repetition have become watchwords of American mass production. Speed has also been an objective of primary importance. So skilfully have these ideas been built into American machinery that even such a delicate affair as the radio tube can be made in large quantities by women with only the most rudimentary training and experience.

Putting such machinery into the hands of workers of other nations, as we have done extensively since the World War, without giving American workmen proper protection, spells competition that can be met only by a slashing of wages and a breaking down of the high standard of living which obtains in the United States and only in the United States.

This is a real danger which surrounds us. It is one with which we must cope.

SINCE the War, we have lent enormous sums abroad, presumably to finance exports. We made these loans without the slightest regard for the laws of good business—we ignored or forgot the fact that there are only three ways of repaying these debts: in gold, which most of our debtors do not have; in credit, which, in the long run, leads only to more credit or to entanglements; or in goods, which would throw thousands of Americans out of work. Thus, upon an already staggering total of war loans, we have piled another mass of debts.

These and similar mistakes are what the Committee for America Self-Contained wants America to avoid. America, the Committee believes, has learned—or should have learned—its lesson in foreign trade. We should formulate a national policy in the light of experience. If this is to be done, what is our first step?

In considering our exports, we must consider the amount of imports we can permit with safety to our industries and labor. The Committee for America Self-Contained does not propose that imports and exports should be completely eliminated. Neither does it propose to cause ourselves inconveniences by striving too rapidly for self-containment. It does propose that we import only commodities which at present we cannot, or that it does not pay us to, manufacture or grow, or that our chemistry cannot produce.

It is proposed to buy from nations who buy from us and in that connection, that our dealings with every nation be perfectly balanced on a bookkeeping basis, passing through and controlled by some central agency.

Only in such a way can we be the masters of our economic life. It is absolutely essential that we keep a ledger in which all outgoing and incoming transactions are strictly balanced. Once we have done this, we can turn resolutely to solving some of our internal problems.

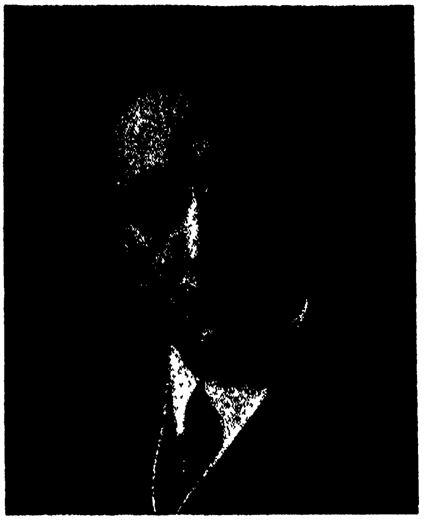
Our foreign trade must be put on a sound bookkeeping basis—a fair return for a fair product. The Committee, therefore, concurs in the action of Congress in granting authority to the President to deal with other nations and to effect an exchange of commodities by means of changes in the tariff. For with the high tariffs and embargoes imposed by other countries today, the situation is such that only through reciprocity can we sensibly extend our foreign trade.

OUR present troubles are due largely to the fact that the buying power of agriculture is below that of industry. In recent years, the incomes of 8,500,000 agriculturists have not kept their ratio with those of industrial workers. For example, in 1927 the farmer made 1387 dollars to the salaried worker's 2084 dollars and the wage worker's 1205 dollars. In 1930, the bottom dropped out of the market; wheat dropped 50 percent; cotton, over 65 percent. In 1932, the farmer made approximately 600 dollars—just barely enough to buy the necessities of life. And what happened? Simply this: 8,500,000 farmers bought far less of industrial products, and, consequently, millions of factory and other workers lost their jobs. And one reason why farm prices have been down is because they have been world prices.

The Committee for America Self-Contained believes the farmer to be a key man in the situation today. If he is helped, buying power of the nation is restored. A simple plan of helping him is suggested by Samuel Crowther in his book, "America Self-Contained:"

"Make the import of all agricultural commodities (wheat, cotton, etc.) that come into competition with our own products discretionary with the Secretary of Agriculture, the discretion being given so that, in the case of a crop failure, the consuming public will not suffer. The Secretary would, for each commodity, then set a domestic quota. For instance, if the records showed that 80 percent of a crop were consumed at home and 20 percent exported, the Secretary would set that quota before the planting season. Then he would fix a minimum price for domestic sales of that commodity—this price being roughly the world price plus the tariff. The export surplus would go out at world prices and would not be of great consequence, for, if the American farmer could get the benefit of the tariff for his domestic sales, he would not have to bother about the price the surplus brought. It would be velvet."

Admittedly, for the time being at least, the farmer of this country must be permitted to sell his surplus elsewhere. The America Self-Contained movement does not aim to stop such legitimate outlets as are at present



James W. Gerard, Ambassador to Germany during Empire days

necessary for cotton, tobacco, and other farm products, but will do everything within its power to make them more profitable. But primarily, American self-containment will aim to assure the farmer a firm, well-paying market for the bulk of his produce.

But there is little point in striving to evolve a program to aid the farmer, if we are to evade the main issue. No domestic plan to improve the farmer's lot will be of lasting benefit until American farm products are freed from world price fluctuations. This can only be done through a clear-cut policy of self-containment.

We are not in the toddling stage of industrial development as are some of our South American neighbors, for example, who must ship raw products and depend largely on others for their manufactured goods. We have raw materials, the brains, initiative, and organizing ability needed to make us economically independent. We have the wealthiest and most powerful economic machine in the world at our command.

Due to the tremendous advances we have made since the war by the use of science, we are no longer dependent upon Germany for our dyestuffs and our medicaments. Nitrates from Chile are being replaced by our synthetic product, which promises to free our fertilizer and explosives industries from dependence on the outside world. Coffee, tea, silk, tin, raw rubber, and a few minerals continue to be about our only important necessary imports. And we are making inroads even here. In America has come the invention of a synthetic rubber, [So-called. There are two: Duprene and Thiokol.—*Ed.*] superior in many ways to the natural gum. This synthetic rubber is still in the process of being perfected, but it promises one day to be profitably adapted to common rubber goods on a mass production basis. Science has freed, or is freeing, us from every important demand on the outside world.

We are right now our best customers. We are not poor. Half of the world's business is conducted within our borders. We have a much higher income per capita—more buying power right here within our borders—than our most fortunate, most successful neighbors. It should be remembered that our export trade, even in prosperous times, is negligible—rarely exceeding 8 percent of our national production. The average income per capita for the whole world, including the United States, was 153 dollars in 1929. For the United States, it was 657 dollars. In 1930, the average retail sales per capita in the United States were 407 dollars, which is larger than the average net income of any people except the Canadians.

THE possibilities of the American market so exceed the possibilities of foreign markets that the adoption of any policy except that of self-containment seems to be flying in the face of common sense and good business.

America self-contained means a higher standard of living for all of us. It means the American market preserved for the American workman. And it means the return of that security which we sacrificed when we began to place so heavy a dependence on the profits of foreign trade.

Once we have restored a balance between agriculture and industry, once our foreign trade is on a sound bookkeeping basis, once our labor is protected against cheap foreign labor, we could achieve economic self-sufficiency and plentifully distribute our great wealth among ourselves. Farm and factory could exchange one another's maximum production.

This goal, American self-containment, is attainable. It is squarely up to us to go toward it through organized planning.

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The Committee for America Self-Contained has headquarters at 57 William Street, New York, N. Y., from which it is sending literature on American self-containment, free upon request.

WINGS OVER WATER

Increased Use of Water-Going Aircraft May Presage a New Era in Aerial Transportation

By REGINALD CLEVELAND

THAT there is a bright future in this country for the development of water-going aircraft is a conviction which I have long held in common with others who have been following the course of aviation. It is of course a truism that between a large majority of the key cities of the United States more and better landing fields are provided by natural bodies of water than by either man-made or natural airports on land. Oddly enough, little advantage has been taken thus far of this condition. An explanation for this failure to grasp what seems a rather obvious opportunity lies perhaps both in the hitherto somewhat lagging development of water-going craft themselves and in the failure to provide facilities on the natural waters for their most advantageous use.

It is decidedly heartening, therefore, to find that the city of New York, aroused to the opportunities which lie in the rivers embracing the island of Manhattan, should at last be doing something about them. The recent news that practical seaplane ramps were to be provided at two strategic points on the East River was emphatically good news. By permission of the War Department these ramps are to be moored, one at the foot of Wall Street and the other at the pier head at East 31st Street. So located, they offer encouragement at once to the private flier, the specialized air-line operator whose activities are confined to comparatively short hops and commuting services, and the operator of scheduled air transport over longer distances.

The outgrowth of plans advocated by George B. Post and Earl D. Osborn—whose Edo Aircraft Corporation has built the pontoons for such well-known sea-going planes as Colonel Charles A. Lindbergh's Orion, which last year made the 30,000 mile survey for Pan American Airways and now hangs in the Hall of Ocean Life in the American Museum of Natural History, and Admiral Richard E. Byrd's special Condor, now in Little America—the ramps are on a generous scale. The plans, drawn by the United Drydocks, Inc., and presented to the city, call for structures 45 by 85 feet in the clear, and weighing 168 tons each.

These plans have been worked out through a co-operative effort on the part of Mayor LaGuardia, his Commissioner of Aviation, F. William Zelcer, and C. Keith Pevear, construction engineer, through the use of Emergency Relief Funds.

THE ramps, secured to the dock structures at the landward end by eye bolts in such a way as to permit them to rise and fall with the tide, slope into and under water. A draft of five feet is provided at the off-shore end, so that even large amphibians coming in with the wheels down will be able to taxi onto the lower end of the ramp without fear of fouling their landing gear. This level is maintained by an ingenious arrangement of the outboard flotation tank, the water level in which is automatically maintained through the use of compressed air and a ball valve.

Midway of the ramp there is a turntable operated by means of a cable and drum arrangement powered by an electric motor. This motor, bilge pumps, and other pieces of apparatus are housed within a second tank, a duplicate of the outboard one in dimensions, which is, in effect, a floating machine shop, and is placed immediately under the land end of the inclined ramp.

In operation, the seaplane or amphibian has only to propel itself onto the lower edge of the turntable which is then revolved, bringing the craft up out of water, and enabling the passengers to alight on the dock dryshod and in comfort. On the shore end, refreshment and rest rooms and an awning covered observation deck are provided, while ample parking space for 20 or more seaplanes is available at the Wall Street ramp alongside a boom, and, at the uptown terminal, on the pier itself. Considering their usefulness, such ramps represent a very small investment. The cost of the two for the East River has been set at about 35,000 dollars each.

Immediate response to the provision of these facilities came in the New York area through the establishment of commuting service by Suburban Airlines, Incorporated. This organization, of which E. O. McDonnell, Richard F. Hoyt, Frank Russell, and other men active both in aviation and financial affairs, are interested, responded by putting on first a commuting service with two trips in each direction daily between Oyster Bay and New York, with intermediate stops at Glen Cove and Port Washington, and a mid-day service for shoppers. The running time is 20 minutes as against more than an hour by train. Before this operation was well under way, plans were formulated for week-end trips to Martha's Vineyard and Nantucket. Extensions of service to Boston, Philadelphia and Washington, or to more distant Long Island points seem well within the possibilities.

Photograph by Margaret Bourke-White

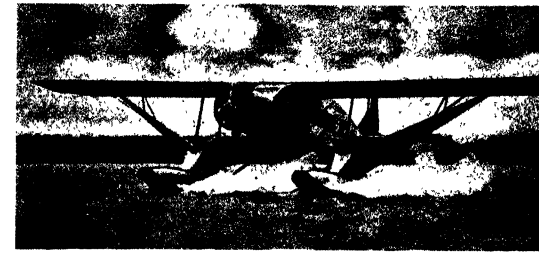
Brazilian Clipper, which recently set 10 world's records for seaplanes

An artist's conception of of the turntable ramps for seaplane terminals in East River, New York

The establishment of ramps of similar type at other cities would make possible airline operation directly to the heart of those cities without the inexcusable waste of time now required to get from airport to business or residential centers. The importance of this lag is, of course, in inverse ratio to the length of the trip by air.

If anything is ever to be done in a practical way with New York City's municipal airport, Floyd Bennett Field, it would seem that it must be done through some such medium as seaplane ramps making possible a ferry service. This 4,000,000-dollar airport development, one of the best fields in the East, is well nigh useless because of its inaccessible location with present means of transit. Among the other excellent factors of Floyd Bennett as an airport, however, is a well-protected seaplane ramp, though not of the ultra-modern kind provided in the East River. It would therefore be entirely possible for transport airlines to land passengers at the municipal port could they be persuaded so to do, transship them to seaplanes, and have them in the financial or shopping district 15 to 20 minutes after landing.

There can be no doubt that the municipal authorities have this development in mind in encouraging the ramp project, for Floyd Bennett is a white elephant not a little expensive to feed, and particularly irritating therefore, to a Mayor who is himself a flier and strongly aviation-minded.



One of the new Bellanca Aircruiser seaplanes flown by Suburban Airlines, Inc., in a commuting service to New York City, using the new ramps described

It is not only in the interesting ramp development, however, that water-going aircraft have received stimulus and encouragement of late. The first of the three S-42 Sikorsky flying boats for Pan-American, in its flight tests, has substantially exceeded the stiff requirements laid down by the airline's engineers working with Colonel Lindbergh, chairman of its technical committee.

This graceful, commodious ship, called *Brazilian Clipper*, which will take two days off the flying time between Miami and Buenos Aires, shows truly remarkable flying qualities. She has made two world's records, the first for carrying a payload of eight tons to an altitude of 15,084 feet, the second for carrying a payload of $5\frac{1}{2}$ tons to an altitude of 21,800 feet.

> **SINCE the writing of the accompanying article, the Sikorsky flying boat, *Brazilian Clipper*, has established eight world's records, aside from the two mentioned. All of the records that were broken had recently been established abroad. The new ones were set up during a flight of the ship over 1244 miles at an average cruising speed of 157.5 miles an hour, using 69 percent of the 3000 horsepower available. The flight was witnessed by an official observer of the National Aeronautic Association and the F.A.I., assisted by 17 other men stationed at checking points along the 311-mile course.—*The Editor***

On a gusty day in July with Colonel Lindbergh at the controls and a total of 31 persons aboard, she readily made 190 miles an hour at 6500 feet, yet landed at not more than 60 miles an hour. Both take-off and landing were really remarkable. At the take-off, the 3000 horsepower of the four Hornet engines was of course utilized at its best by means of controllable pitch propellers, but here too Igor Sikorsky's adaptation of the flap came into play. In this monoplane, the flap is not a split flap in which part of the trailing edge is lowered, leaving the upper segment in place. Instead, the after portion of the entire wing from aileron to aileron is deflected downward, thus changing the camber of the wing and giving marked increase in lift without parallel increase in drag.

On the day in question, with Edwin C. Musick, chief pilot of the air line, at the controls, the great plane fairly leaped into the air after a take-off run of 15 seconds. In half a minute it was 500 feet above the water.

QUITE as remarkable, at least to this observer, as its agility is the steadiness of the *Brazilian Clipper* on the water and in flight. There was a $2\frac{1}{2}$-foot sea running when I rode in her, enough to prove that she was a comfortable sea boat. The air was rough and bumpy, so that pilots coming into the Bridgeport field had all remarked the gusty conditions aloft. Yet the *Brazilian Clipper*, either coasting along at 100 miles an hour with flaps partly down to enable photographic planes to keep abreast, or opened out and doing 190, was as steady as a rock. One would not have imagined there was a bump within leagues.

This to me was a satisfactory demonstration of the soundness of a most interesting study which Mr. Sikorsky had told me of some months before. The study in question was that of the wing loading of birds. He had found, he said, that while a large land bird, like the condor of the Andes, which alights relatively frequently, has a wing loading of a pound and a half a square foot, and a wing relatively broad or of low aspect ratio, the soaring birds, like the albatross, that keeps awing for days on end through storm and calm, have a heavy wing loading, three pounds per square foot for the albatross, and a high aspect ratio.

Following this object lesson of nature, the S-42's have a narrow wing and a wing loading of 28 pounds per square foot. They cleave the gusts unmoved.

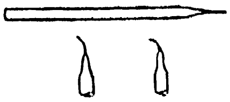
THE AMATEUR AND HIS MICROSCOPE—XII

SOME TRICKS OF THE TRADE

By JOHN F. BRANDT
Bausch & Lomb Optical Company

WE cannot study the microscopic very long without acquiring a very firm belief in the importance of small things. The same is equally true in everything else. We would not look forward with equanimity to being operated on by a surgeon who had never held a scalpel in his hand but who had read books on surgery by the hundreds. Why? Mainly because we could not be sure that he had learned those tricks of the trade which would allow his patient to go around saying, "Have you heard about my operation?", instead of asking, "Have you a size 7⅛ halo?"

In general, these little tricks of the trade are quite overlooked by the books on any subject. The author himself either uses them so naturally that he has quite forgotten that they are not a part of the equipment of the beginner in his subject, or else he was forced to leave them out because of the necessity of cramming a life-time study between the two covers of a single book Once in a while, however, writers forget the rules, or memories of their own early days come suddenly to start their hands awriting. Let us see what we can find among these most fortunate lapses—"tricks of our trade in microscopy."

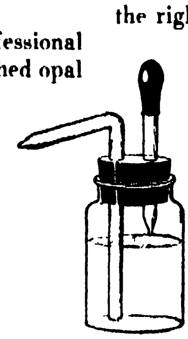


Points on glass tubing drawn out into thin air

KEEP BOTH EYES OPEN: There is nothing new about this rule of using the microscope. But how many of us have tried it and at last have taken instead to holding our hand over the other eye, or at least to squinting? You will find it a great help if you place the microscope on a sheet of dull black card, such as that which is used for making signs and price tags in department stores. Its use is a case of simply following the principle of not having any bright light reflected into the "other" eye, which you are trying to forget. If you slant your head slightly, so that the eye you are not using looks away from the microscope, instead of along the body tube, you will find it a help. An eye shield, with notch for the nose, may be placed at the eye piece.

FINE FOCUSING: You can make a satisfactory adjustment of the focus on microscopes which have a draw tube but no fine adjustment, by focusing as carefully as possible with the coarse focusing adjustment and then moving the draw tube up and down very slightly with a twisting motion.

ILLUMINATION: Many professional microscopists use a piece of flashed opal or ground glass directly in front of the mirror, even though the light source has its own ground glass window. You need only to have a piece of glass large enough so that the top edge can be leaned against the front edge of the stage on the microscope.



A wash bottle for the microscopist's use

Filters are excellent things to use for both visual and photomicrographic work. As soon as you become accustomed to them you will find that they have greatly increased the resolution of the microscope and are easier on the eyes. The green filter used in photographic work is recommended. This can be bought of any photo supply dealer. If you would like to experiment with different color filters, without going to too great an expense, you can make some yourself. Fix an ordinary photographic glass negative without first exposing it to the light. The gelatin that remains on the plate may now be tinted with various colored dyes as you wish. Simply dip the plate in a bath of dye, or paint it with a soft brush.

A SIMPLE LIFE CELL: One of the difficulties of studying or photographing living protozoa and infusoria is that they insist on swimming hastily out of the field of view. After a while you begin to think that they certainly must be very self-conscious creatures who resent this intimate inspection of their daily life. There are several methods of slowing them down (dissolving a tiny menthol crystal in the water, or thickening the medium with gelatin) but you can also make a cell just the size of the field of view. Mould some paraffin by melting it and pouring it into a tube made of ordinary writing paper, slightly larger than the size of the cover glasses you are using. When the wax is hard, drill a small hole in the center, the size of the field of view at whatever powers you wish to use. This, naturally, requires a trial and error method and examination under the microscope. When you have the right sized hole pierced in the paraffin, slice off a very thin section of it, either in a microtome or with a wet razor blade. Again use the trial and error method to determine when the sections are of just the right thickness to prevent the organisms from swimming out of focus. Rub a little Vaseline on both the top and bottom of the section, place it in the middle of the slide, drop the organism into the hole in the center and cover with a cover glass. Mr. Infusoria is now forced to remain in the spotlight!

THE WELL KNOWN AMŒBA: If you have had difficulty in finding that very interesting bit of protoplasm, the amœba, here is a method of capturing which usually gets results. Gather a handful of dried leaves that have fallen from any tree, and boil them in water until you have a nice thick soup. Pour the whole thing into a quart jar and allow it to cool to room temperature. Now put in a few more dried, but uncooked, leaves and wait for a scum to form on the surface of the water. In this scum you will find, in all probability, a large number of amœbas, though they will be somewhat smaller than those usually found on the leaves and stems of pond plants.

An eye shield for the microscope

TURN THEM OVER! The micro-manipulator is a device for dissecting, injecting and generally annoying microscopic specimens. The tools used on the micro-manipulator are simply small glass tubes drawn out to a fine point. The author has known professional microscopists to get very good results simply by using these tools in their own

hands. If you feel like experimenting, purchase some capillary tubing from a laboratory supply house. Heat this over an alcohol lamp or a micro burner, as the Bunsen burner or the flame of a gas stove is so hot that it makes somewhat difficult handling. When the tubing is sufficiently soft at the heated point, draw it out so that it has about one half of its original thickness and allow it to cool. Again heat it in the center of the thinner portion thus produced and, when soft, draw it out sharply until it pulls apart, leaving a very sharp point. The result is a small glass "poker," whose handle is the original size of the capillary tube, its end narrowed down to about one half that thickness, and then abruptly fading off into thin air. It takes some practice to make these properly, and you will often break them, but they will offer no end of possibilities. The point can be bent, straight or curved, as you wish.

THE WASH BOTTLE: You are probably familiar with the wash bottle used in a chemical laboratory. In microscopic work we must use very small quantities of liquids on occasion and this wash bottle is a very convenient form. We can easily make one or several for our own laboratory. The necessities are a bottle of whatever size you wish, a two-holed rubber stopper to fit this bottle, a short length of glass tubing and an ordinary medicine dropper.

The glass tubing is heated over a gas flame or Bunsen burner, and drawn out and broken off so that it has a very small opening. It is again heated in about the center and bent over to something less than a 90-degree angle. The unpointed end of the tube is now inserted far enough into the rubber stopper so that, when the stopper is inserted in the bottle, the tubing comes just a little above the bottom. The medicine dropper is inserted in the other hole in the stopper, but not far enough down so that its point will touch the reagent or dye kept in the bottle. When the bulb of the medicine dropper is pressed the atmospheric pressure drives the liquid up and through the tube so that it can be deposited on the slide in whatever quantity is desired. When the bulb is released the liquid in the tube is pulled back into the bottle, accompanied by some air which makes up in volume for the amount of liquid used. Since the tube is bent over, no dust can get into the liquid. An empty bottle of this type may also be used for sucking out excess liquid, as in a live cell.

EMBRYOLOGY: If you are interested in embryology it is not absolutely necessary that you go in for chick embryos and the like. Fish eggs can be studied from the moment of laying up until the young finally absorb the yolk sacks, without any difficulty and at almost no expense. The small tropical fish, which can be purchased at any pet shop or aquarium store, are the best for the home aquarium and are extremely interesting in themselves. The necessities are a five-gallon aquarium, some sand, plenty of plants to oxygenate the water, and a heater and thermostat to keep the water at about 76 degrees.

Place the tank in a north window where it will receive plenty of light, but not sunlight. Medakas are beautiful little fish, and a pair of these is quite inexpensive and easy for the beginner to breed. Their eggs will be found to resemble tiny bunches of grapes hanging on the seaweed.

A MICRO-PROJECTOR: For your own amusement and that of your friends, a micro-projector should be a part of your equipment. The only essentials, aside from your microscope, are a powerful illuminating source and some form of screen. A 100-watt bulb will serve as an illuminant. A 52-candle power automobile headlight bulb, also, is excellent because of its concentrated filament. Mount the bulb in any convenient manner to direct the light to your microscope mirror, or into the condenser if the microscope can be inclined. If possible, form an image of the light source on the specimen with a condenser. A number of different materials can be used for screens. A large sheet of smooth white paper, thumbtacked to the wall, makes a very good projection surface. These can be purchased from a printer. Draughtsmen's tracing cloth stretched tight in a two-foot square frame of wood forms a "translucent" screen. That is, the screen is between the micro-projector and the audience, which sees the image as if on the ground glass of a camera. Plan to project at the lowest powers of your microscope at distances from two to four feet, unless you have an extremely powerful light source.

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EDITOR'S NOTE: *We have received for review a copy of a newly published book entitled "Adventures with the Microscope," by Julian D. Corrington, Ph.D., microscopist of the Frank A. Ward Foundation of Natural Science at the University of Rochester, and have read this volume with keen interest. It covers just about everything under the shining sun which could be regarded as possible work or fun for the amateur microscopist. the microscope and its operation; microscope accessories; col-*

Bright and dark field illumination contrasted—dark above and bright at left. In the dark field illumination the light strikes the object from the sides, and none comes into the eye directly; what does reach the eye comes from the object. It very often reveals added details

lecting microcosmic materials (protozoa, algae, and so on); soil microscopy; mineral microscopy; insect microscopy and technique; hair and fur microscopy; photomicrography; drawing with the microscope; plant studies (sections); bacteria studies; tissue study; microscopy of body parasites, and other things. No such book has ever been made available to the English-speaking amateur, and this is the book we have long wished someone would write, for there has been no all-around hobby book for the amateur microscopist and we have been forced to recommend makeshifts. Its viewpoint is strictly amateur and it is practical. It has 455 pages and 365 illustrations, and is a large book.

In a whimsical chapter at the end we learn from Dr. Watson that Sherlock Holmes has found a suitable occupation for his later years, having established the "Sherlock Holmes School of Criminology," in Baker Street, his old haunt. Microscopes appear to be the sun around which the school revolves—microscopes for comparing earth samples, bullet comparison microscopes, hair and fiber, finger-print microscopes, and so on.

We do not sell this book, although it can be purchased. It is sponsored by the Bausch and Lomb Optical Company of Rochester, New York, and its sale is mainly linked with the sale of a microscope. In spite of this we can sincerely recommend it as an excellent work.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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Bathysphere Has New Quartz Windows

EARLY in August Dr. William Beebe and his associate, Otis Barton, broke all deep-sea diving records in their bathysphere by descending 3028 feet beneath the ocean surface off Bermuda. This famous spherical diving chamber is equipped this year with windows of fused quartz, the blanks for which were furnished by the General Electric Company and were accurately ground and polished by the A. D. Jones Optical Works.

These clear fused quartz windows provided perfect protection during the record dive and no doubt will prove as satisfactory at still greater depths to which Dr. Beebe and Mr. Barton expect to descend shortly. Fused quartz has a crushing strength somewhere between six and sixteen times that of glass, while its low coefficient of expansion permits the windows to be subjected to severe changes of temperature without danger of cracking; yet the transparency is higher than that of glass.

The three fused quartz windows used in the bathysphere—eight inches in diameter and three inches thick—are made from the highest quality of rock crystal fused in a vacuum and then subjected to high gas pressure while in the molten state. If such a large mass of crystal as is necessary to make each of these windows were fused in air it would be opaque due to innumerable gas bubbles, but by fusing in a vacuum, the number and size of bubbles is greatly reduced, and many of those remaining may contain gas at a very low pressure or are evacuated spaces caused by the condensation of silica vapor which formed them at the high temperature of 1800 degrees, Centigrade, necessary to cause fusing.

Tightening clamps that hold the quartz windows in the bathysphere

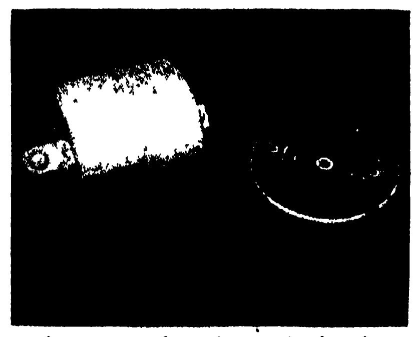
In spite of the manufacturing difficulties, the round quartz blanks used for the bathysphere windows cost as little as 160 dollars each, in the rough.

Fused quartz bathysphere windows

In the Bermuda seas, many millions of strange creatures that inhabit the blackest of the ocean half a mile deep will be studied by Dr. Beebe, who now will be able to photograph all stages of sea life—protected by accurately ground and polished fused quartz windows of maximum strength and transparency.

Noiseless All-Wave Radio Antenna System

A SINGLE antenna with automatic frequency selector and impedance matching switch whereby either an ideal broadcast or ideal short-wave antenna circuit is provided for intercepted signals, with a positive minimum of background noise, is announced by the Technical Appliance Corporation of Long Island City. Known as the H-F (High-Fidelity) All-Wave Antenna System, the arrangement is available in complete kit form including wire and insulators, or as individual antenna and receiver units.



Antenna and receiver units for the new noiseless radio antenna system

This noiseless all-wave antenna system is intended primarily for all-wave receivers. It provides the efficiency heretofore attained only through the use of separate broadcast and short-wave aerials, with the added feature of minimum background noise.

Two units comprise the heart of the system. The antenna unit, a compact aluminum-encased device with screw binding posts to hold the ends of the aerial wire, is inserted at or near the center of a single-wire aerial. The unit automatically routes signals through the most desirable combination of aerial and downlead. The companion set unit, mounted near the receiver, is provided with a switch for impedance selection whereby to obtain the most effective coupling between receiver and downlead. A twisted-pair cable for the downlead cancels out inductive interference or background noise, including the usual troublesome automotive ignition interference. The new system is licensed under the A. A. K. antenna system patents.

Chemicals Repulse Ravages of "Red Tide"

TURNING back the "red tide," which periodically sweeps in from the sea to wreak havoc with the pearl-oyster beds along the coast of Japan, is one of the most recent and romantic applications of modern chemistry. Large areas of the sea along Ise Bay are used for the cultivation of pearl-oysters and the jewels produced by the crustaceans are the basis of a large and

prosperous Japanese industry. But even the pearl growers have their trials and tribulations, for now and then the "red tide" appears—an onslaught of red micro-organisms, so small that 25,000 of them have plenty of room to circulate in a single cubic centimeter of sea water. But they color the water red—and they cause millions of dollars worth of damage each year to the pearl-oyster beds.

Japanese chemists have found that they can halt the ravages of the "red tide" by diffusing certain chemicals through the oyster bed. A solution of ferric chloride does the trick; so does chlorine gas. Motor boats have been rigged up with apparatus to spread these chemicals through the infested areas by discharging a stream of them from the stern of the boat in such a way that they are churned into the water by the propeller.—*A. E. B.*

Snakes Not Speed Demons

THE popular idea that snakes move with extreme rapidity was put to test and found wanting in snake speed trials made and reported before a meeting of the American Association for the Advancement of Science by Dr. Walter Mosauer of the University of California at Los Angeles.

A man can walk faster than the fleetest snake, upon which Dr. Mosauer held a stop watch, can glide, for the maximum velocity did not exceed three and one third miles per hour, approximately equivalent to 67 seconds for the hundred-meter dash.

The snake's reputation for speed is based on the deceptive grace of its smooth, fluent undulatory gliding, Dr. Mosauer concluded. The snake's apparent flashing speed is an optical illusion.

Of seven typical North American snakes tested, the red racer was speediest, while the California boa, with a rate of only a quarter-mile per hour, was slowest of all.

Dr. Mosauer admitted that these speed records might be broken by vigorous and excited reptiles during sudden speed bursts and that some tropical snakes may double or treble the American records. But he is confident that a man can easily outrun any snake of the United States and possibly of the world.—*Science Service.*

Bottle Seal Cannot be Counterfeited

SCIENTISTS, setting about to foil the bootlegger, have developed a type of seal for bottles which cannot be counterfeited. The Bureau of Industrial Alcohol of the United States Treasury Department has approved the use of these seals over the government tax stamp, according to the manufacturers of this new protective device.

Bottle seals that cannot be copied

During prohibition, bootleggers developed imitation into more or less of an art and thereby were enabled to give liquor packages every appearance of being genuine. With the coming of repeal, the practice has been continued.

The principal reason why the new seals cannot be simulated is because the cellulose material used in making them can be produced only in a plant involving a heavy investment of capital and requiring an unusual degree of technical knowledge and skill for its operation. Besides, these protective seals can be obtained only by reputable concerns or individuals.

There are two styles of these seals. One is so made that it is sufficiently transparent to permit seeing the government stamp through it, though it appears opaque from a distance and provides a background for the trade mark of the distiller, a facsimile signature or lettering.

The other style is opaque front and back, but has transparent "windows" at the sides which give a clear view of the strip stamp. The opaque portions provide space for a trade mark or other means of identification. The identifying mark is applied by the impregnation of the seal material during the process of manufacturing. This is a secret method and cannot be imitated by bootleggers.

The seal, as it comes from the factory, is in the form of a band or sleeve and is moist. It is applied over the cork or stopper and the neck of the bottle and the government stamp. As the band dries it shrinks tightly around the container.

WALTER FRANKLIN PRINCE

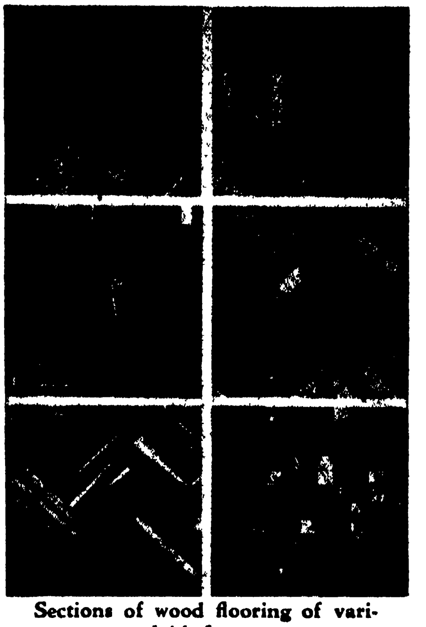
READERS of Scientific American, familiar with the writings of Dr. Walter Franklin Prince, will grieve to hear that Dr. Prince passed away on August 7 at his home in Hingham, Massachusetts, at the age of 71. A graduate of Yale, Dr. Prince has long been associated with psychic research work, at first with the American Society for Psychic Research, and later with the Boston Society. He was also Past President of the Society for Psychical Research, London.

For many years Dr. Prince was a member of the staff of Scientific American, co-operating actively in all matters pertaining to psychic phenomena, and contributing numerous articles on allied subjects to these pages. We mourn the passing of our fellow worker, who has left a gap in the ranks that will be difficult to fill.—*The Editor.*

Floors of Many Woods

FLOORS in 30 rooms of the United States Forest Products Laboratory, Madison, Wisconsin, have been laid with a varied and colorful assortment of American woods to demonstrate and test the merits of different patterns and finishes, as well as to acquaint the general public with the attractions of different species and types of grain. The materials range from straight-grained quarter-sawed western hemlock laid up in conventional lengths to walnut laid in 8-inch built-up squares.

Three main types of flooring are now in place throughout the Forest Products Laboratory as a whole--wood flooring strips and blocks, pressed wood fiber tile, and linoleum, the last-named qualifying very appropriately among forest products because of its large content of cork, wood flour, and forest-produced resins and oils. All of the floors were laid over concrete of average flatness. Some of the woods used have only recently been considered for flooring purposes, and others were installed to demonstrate unusual effects that can be obtained when extreme durability is not essential.



Sections of wood flooring of various types, laid for test purposes

Overweight Men Healthier and Stronger

OVERWEIGHT young men have more physical endurance, greater resistance to infectious diseases, and are less likely to develop nervous or mental disorders than young men who are underweight.

These conclusions were drawn from a study of accepted entrants to the Royal Air Force and were reported by Dr. H. A. Treadgold, Group Captain, Royal Air Force, to *The Lancet*, medical journal published in London.

Dr. Treadgold compared the men's weights when they entered the Royal Air Force with their accomplishments in athletic competition and records of sick leave and invaliding from the Service.

"There is a definite relationship between varying degrees of body-build and functional efficiency, whether viewed from the points of capacity to endure severe or prolonged physical or mental stress or resistance to disease generally," he found.

"Capacity to endure severe or prolonged physical stress as evidenced by athletic prowess is found most commonly among the over-weights. An exception to this is seen in long-distance athletes among whom

underweight is commoner than overweight.

"The greater the degree of underweight on entry, the greater the likelihood of invaliding from the Service on medical grounds.

"It is uncommon for overweight individuals to become underweight and vice-versa."
—*Science Service.*

Scientific American Inspires Development of a Modern Geophysical Instrument

THE October, 1932 issue of the SCIENTIFIC AMERICAN described briefly an instrument for detecting the presence of electrically conductive ore beds and metallic deposits which are buried at moderate depths beneath the surface of the earth. This instrument, which was termed an Ore Detector, was designed and constructed, on special order from mining interests, by the geophysical firm of William M. Barret, Inc. This organization now announces the development of a simpler, more portable, and decidedly more economical instrument, the Terrometer, for accomplishing the same results as their original special-order apparatus, and which is suitable for general distribution. "The development of the Terrometer," says Mr. Barret, "was largely prompted by the evident and genuine interest aroused by our special-order apparatus described in SCIENTIFIC AMERICAN."

The new instrument consists essentially of a high-frequency oscillator and sensitive detector, maintained in rigid alignment by supporting arms, and provided with carrying handles for manual transportation. The Terrometer is equipped with a rugged pointer-type galvanometer for indicating the response due to the presence of differential conductivities.

In operation, the oscillator produces a high-frequency electromagnetic field which not only reacts on the detector but enters the earth and penetrates to a considerable depth. Initially the orientation of the oscillator and detector is such that, with no disturbing mass in the neighborhood of the instrument, a minute exciting current flows in the detector circuits. The magnitude of the detector excitation, which may be controlled by varying the angularity of the oscillator, is so adjusted that approximately midscale deflection is indicated by the galvanometer connected to the output terminals of the detector. If an electrically conductive mass be now brought within the effective range of the oscillator field, then this mass causes a secondary field which reacts on the detector circuits and thereby produces a change in the galvanometer reading.

The Terrometer is particularly suited to mapping the distribution of buried pipelines which transport oil, gas, water, and so forth; to mining problems involving the detection of relatively shallow deposits of elements and minerals whose conductivities differ sufficiently from the country rock; to the search for buried treasure; and, in fact, to the multitude of problems that require the location of hidden masses of electrically conductive materials, or materials whose conductivities differ sufficiently from that of the surrounding media.

Two easily carried units constitute the geophysical instrument

The manufacture and distribution of the Terrometer will be under the direction of the Engineering Research Corporation, Giddens-Lane Building, Shreveport, Louisiana.

Showing how the geophysical instrument is carried when in use

Tin Preserves Grapefruit

WHILE chemists are energetically searching for some substance, such as an enamel, with which to coat the inside of tin cans to prevent attack of metal by contents, along comes the odd discovery that the very action they seek to prevent seems to be beneficial, at least in the case of one popular delicacy—canned grapefruit. A. E. Stevenson, writing in *Industrial and Engineering Chemistry*, reports that experiments have been made with several different enamels but none, so far, has been as satisfactory as plain cans.

Canned grapefruit when stored at ordinary temperatures gradually becomes slightly yellow. When packed in plain cans, the reducing action of tin has a bleaching effect which retards color changes. In the enameled can, the color change, therefore, is more rapid. In addition, grapefruit packed in enameled cans has a slightly different and less agreeable flavor than that in plain cans; this difference in flavor is apparently connected with changes which are retarded or prevented by direct contact with tin. The change in color of grapefruit in plain cans, together with the toughening which accompanies it, is retarded by low storage temperatures.—*A. E. B.*

Is "Empty" Space Empty?

THE cluster of stars or galaxy of which the sun and the earth are a part is only one of 100,000,000 similar galaxies which modern telescopes can now see, declares Dr. J. A. Anderson, astronomer of Carnegie Institution's Mount Wilson Observatory.

In our own galaxy there are over 10,000,000,000 stars. So spread apart are they, however, that if each one were represented by a tiny raindrop only one eighth of an inch in diameter, each would have to be separated by a distance of four miles from the next one to present a picture of our galaxy in respect to its star distribution, declares Dr. Anderson.

Thus only a minute fraction of space is occupied by matter. "Is the rest empty?" asks Dr. Anderson. Not necessarily, he says. There is good evidence that in the emptiness of space between the stars of our own galaxy there exists a very tenuous medium consisting of neutral atoms of sodium and ionized atoms of calcium which have lost one electron and become electrified. Some estimates, Dr. Anderson declares, maintain that the total mass of this tenuous matter is about equal to the mass of the 10,000,000,000 stars the galaxy contains.

Flying about through space also, he says, is the enormous amount of energy given off by all the stars in the form of radiation. In part the radiation is visible but much of it is invisible. —*Science Service.*

New Type Electric Refrigeration

IN its announcement recently of a radically new type, low-priced electric refrigerator, the Crosley Radio Corporation has taken another important step in its efforts to make electric refrigeration available for practically every family. This latest development is a small, compact, highly efficient electric refrigerator chest—the first of its kind to be offered by the industry.

A new low cost electric refrigerator, in which the flat top is the door

Contrasting with the ordinary electric refrigerator with its door swinging out from the front, the new "Chest Shelvador" opens at the top. It has a capacity of two cubic feet net and 4.2 square feet shelf space. Additional storage space for small articles of food is made available through this unique door. The standard Crosley compressor with a ⅙ horsepower motor assures both highly efficient refrigeration and low electrical current consumption. The two ice trays have a capacity of at least two pounds of ice.

A Noteworthy Amphibian

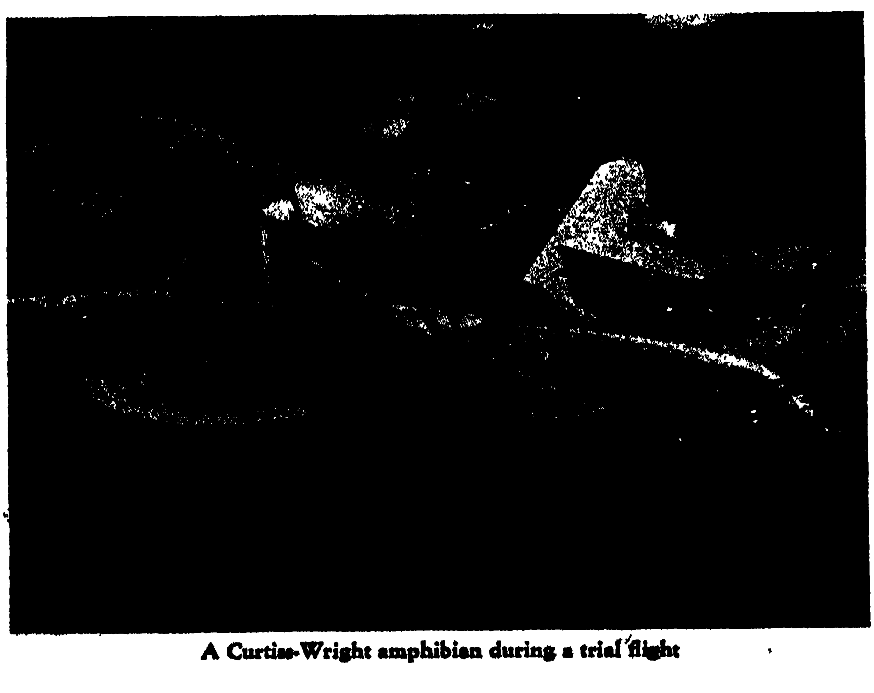
ONE of our photographs shows a new Curtiss-Wright amphibian designed by Captain Frank Courtney, in one of its flight tests over Long Island Sound. In these columns we no longer seek to describe even briefly every new airplane that is placed on the market. The comparatively new airplane art has reached a certain stage of convention and similarity, but this new amphibian has many novel features.

The power plant is of distinct originality. A 365 horsepower Whirlwind engine is employed, mounted well forward within the upper wing of the biplane cellule. Yet a "pusher" propeller is used; that is, one mounted in the rear of the wing. This rear mounting of the propeller is possible because the drive is carried aft on a short extension shaft. The arrangement offers a number of advantages. The propeller is clear of the cabin, which greatly facilitates docking. At the same time the engine is provided with a streamline cowling, which leads to greater propeller efficiency and reduction of drag, and its accessories are more readily accessible. The nose of this cowl is in itself the oil tank, so that excellent oil cooling is possible without extra drag.

The next feature of interest is in the landing gear. Flying boats and landplanes of the same size handle just about the same in the air, but they are not piloted in the same way on taking off or landing. Many a skilled Army pilot has found himself in trouble when in charge of a flying boat or seaplane. For an amphibian it is highly important that the process of take-off or landing should be exactly the same whether on land or on water. In a flying boat the machine alights tail low, first touches the water on the step, which is placed some distance back of the center of gravity, and then gradually falls forward on the nose. In the ordinary land plane the front wheels touch first and then the machine gradually falls down on the tail. There is a distinct and obvious difference in the two processes. In the Curtiss-Wright amphibian however, the main two wheels are placed to the rear, and a single front wheel is placed at the extreme nose of the hull. A little reflection will show that landing on land or alighting on water will therefore call for the same maneuver by the pilot. Still another advantage of this rearward wheel arrangement is that the main wheels can be completely enclosed in the hull without interfering with the cabin arrangements.

Our readers may also note a mast at the nose of the hull. It is into this mast that the nose wheel support retracts. At the same time this mast is extremely useful as a handhold when docking or mooring.

The general design is excellent. With pilot, four passengers, ample gas and fuel, marine gear, and 120 pounds for luxury equipment, the gross weight is 4650 pounds. The top speed is 151 miles per hour, which is excellent for this type and load and power. The span is relatively small—40 feet—making for easy accommodation. With reversible passenger seats, card tables, easy entrance through the front hatch without interference by the slipstream, and so on, we have an air yacht well adapted to the needs of the private owner.—*A. K.*



A Curtiss-Wright amphibian during a trial flight

A Noise Analyzer for the Airplane

IN studying the sound proofing of airplanes it is important to know not only the noise level in decibels but also the frequency or pitch of the noises. This is because some methods of sound proofing are better suited to one pitch than to another; because some pitches of sound are more annoying than others; and because it is important to know the source as well as the intensity of the sound.

To meet this situation Westinghouse engineers have developed a sound frequency analyzer which has given excellent service in tests of a General Aviation airliner. The

Analyzing the noise in an airplane

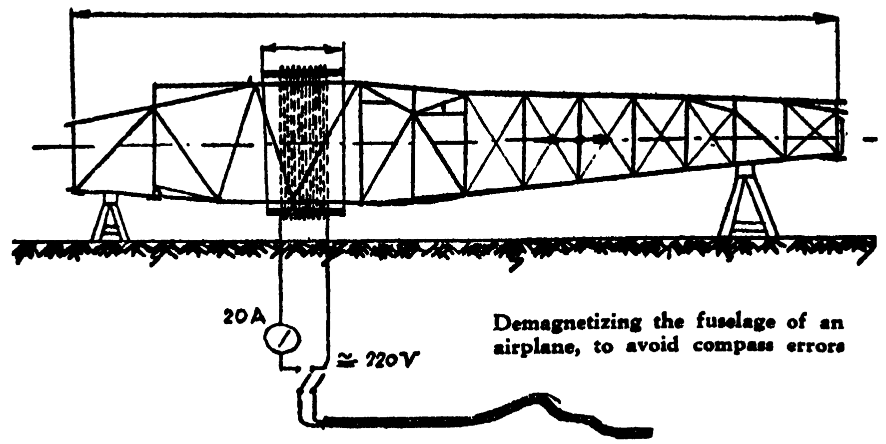
analyzer has indicated not only the general sound level, but also the sound level of different types of noises.

The filter which picks out the varying frequencies consists of a brass rod supported at the center in such a manner that it will respond to longitudinal vibrations. Attached to each end of the rod is a small coil that floats in a steady magnetic field. The detector output is applied to one of these coils, so that when the detector current contains a component of resonant frequency with the sound wave a vigorous longitudinal vibration will be set up in the rod. The voltage generated in the other coil due to this vibrational velocity is then amplified and measured by the output meter.

The central support of the rod is in the form of a flexible diaphragm, so that if there is any unbalance between the two halves of the filter, the support will allow the rod to seek its own natural nodal point. Since the natural frequency of the filter is quite high, the diaphragm need not be so flexible as to cause a lack of rigidity in the structure. The effect of extraneous nodes of vibration is eliminated by clamping the diaphragm between layers of soft rubber and by a tuned transformer in the amplifier circuit.—*A. K.*

De-Magnetizing a Fuselage

IN a flight from Vienna to Budapest, Monsieur Safarik of the French Bureau Veritas in Prague had his plane struck by lightning. As a result, the metal fuselage of his craft became so strongly magnetized that it was found impossible to compensate for the errors of the compass. Without a compass a pilot cannot navigate and it was at first thought necessary to junk the fuselage. Vibrations encountered in subsequent flights had no apparent effect on the magnetization. Annealing the metal was too hazardous; such annealing would have eliminated the magnetization but would have reduced the strength too much.



Demagnetizing the fuselage of an airplane, to avoid compass errors

Finally a practical expedient was arrived at, which is illustrated in the sketch. On a wooden frame large enough to embrace a portion of the fuselage at its maximum diameter, a number of turns of copper wire were wound. The coil thus formed was connected to an alternating current circuit of 220 volts. After the coil had been subjected to this alternating current for an hour it was moved along the fuselage. Under the influence of this electrical "massage," the apparently permanent magnetization disappeared entirely. This process has been repeated successfully a number of times and is a useful thing to remember for aircraft operators.—*A. K.*

Insulation for Airplanes

VIRTUALLY unanimous acceptance by European airplane manufacturers of Seapak, insulation material manufactured here, is announced by the Seaman Paper Company. According to authentic reports, 16 foreign manufacturers of cabin planes throughout Europe and in England have adopted and are now using Seapak for the sound and temperature insulation of passenger cabins.

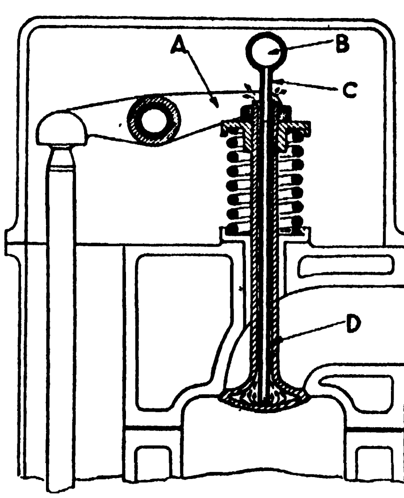
Seapak, which consists of kapok in flexible sheet form, is only two years old in this country, and its introduction into foreign fields began less than a year ago. In addition to use in planes, this material has made progress in the foreign automobile and railroad field. It has been adopted for insulation of bodies by the Bianchi and Hispano Suiza cars, and for dash insulation by the Saurer car, made in Switzerland. Breda, maker of sleeping cars, is using it in these cars and in first and second class carriages.

This progress follows the success of Seapak in this country in the transport plane field. Practically all American transports are Seapak insulated.

Oil-Cooled Exhaust Valves

THERE is no part of the aircraft engine which has to meet such severe operating conditions as the exhaust valve. The rise in the temperature of the exhaust valve is a constant difficulty and a frequent cause of pre-ignition. In the United States, salt-filled exhaust valves have been used extensively, and now we learn of an oil-cooled valve, invented by a well-known British engineer, R. C. Cross.

Our diagram shows the arrangement of a Cross oil-cooled valve in a form which may be applied to either an aircraft or an automobile engine. A tube "B" is connected to the oil supply, and has attached to it a small tube "C," which passes through a hollow stem of the valve into the hollow valve head. Between the tube "C" and the walls of the hollow valve stem is a small annular space "D." The cooling oil passes through the tube "C," returns through the annular space "D," and splashes into the overhead valve chamber. "A" is the valve rocker arm.



Cross-section of an oil-cooled valve

The Cross valve, of course, is applicable only to engines in which the overhead valve mechanism is totally enclosed. With the open type of valve gear found on many engines, the oil returning from the valve head and stem would be flung out, and, apart from the loss of oil, would make the airplane behind the engine intolerably dirty.

To convert any engine to the use of the oil-cooled valve it is only necessary to arrange for an oil pipe from the general supply and to bore out the valve guides to take the larger valve stems. Tests have shown that the new valve works well, and no carbonization of oil inside the valve stem has been noticed.—*A. K.*

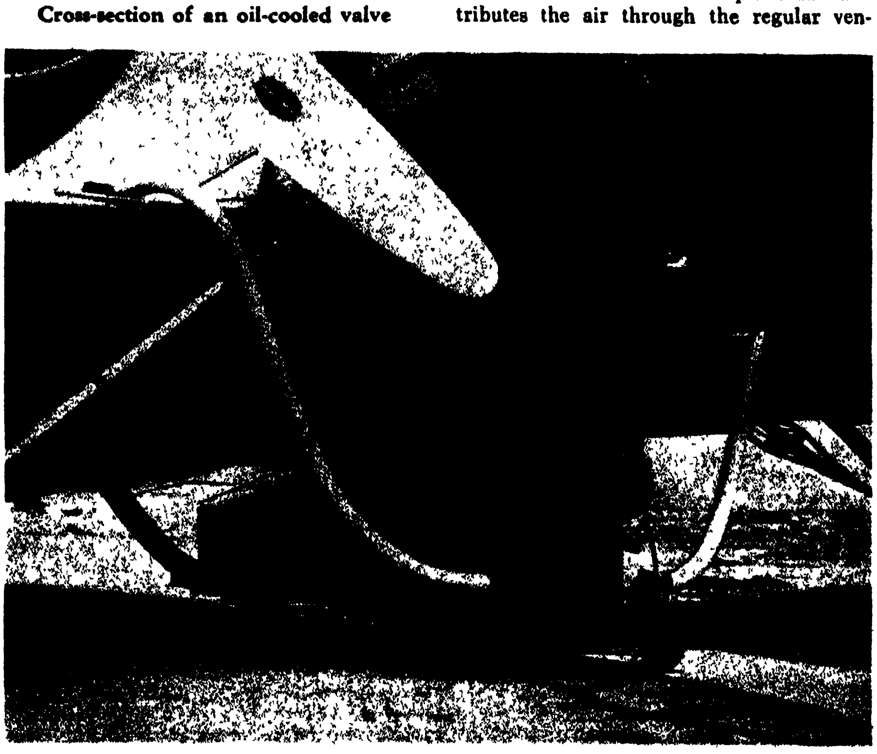
Air-Conditioning the Airplane Sleeper

PULLMAN sleepers have, as we know, been air-conditioned for the last two or three years. The progressive airplane people do not lag a whit behind the Pullman.

In the air, the flying speed provides plenty of cool, fresh air, through the regulating system already built into the machine, and the exhaust heat of the engine also provides adequate heat when necessary. But on the ground, when the engine is stopped, these conditions do not obtain. Therefore, the Curtiss-Wright Airplane Company has provided an ingenious unit for use on the ground, which provides hot or cool air as desired.

This ground ventilating unit shown below the fuselage of the Curtiss-Condor in our photograph is a combination electric refrigerator, electric heater, and ventilator, thermostatically controlled. It can keep the cabin at a comfortable temperature at all times, and is powerful enough to change the air in the cabin completely in two minutes.

This unit fits under the airplane and distributes the air through the regular ven-


Air-conditioner for planes, in use at an airport

tilating and heating channels. It might be argued that this is a superfluous comfort, since passengers never spend more time in the airplane than is necessary to get from point to point. This was true a short while back, but nowadays passengers get into an airplane sleeper in exactly the same way they get into a Pullman sleeper, and may be a couple of hours in bed before the ship flips away. Under these circumstances the new air-conditioning unit appears entirely logical.—*A. K*

Copper Keeps Cut Flowers

WHEN cut flowers are put in copper vases, they remain fresh from one to three days longer, according to the findings of John Ratsek, floriculturist at the New York State College of Agriculture. In one test, poinsettias lasted 16 days, against eight days in a tin container.

This is due to the fact that some copper dissolves in water, says *Chemistry and You*, and hinders the growth of bacteria which cause flowers to wilt. Roses, snapdragons, stocks, delphiniums, primroses, carnations and other popular varieties of cut flowers keep longer.

Hobbies on Parade

SCIENCE dwelling in the American people to an unsuspected degree was revealed at the Hobby Show staged recently by the Toledo Museum of Art. The purpose of the show was to discover what Americans really are doing in their much discussed leisure time, and for that reason no restrictions were placed upon the exhibits. The privilege of exhibiting was limited to workers in a Toledo scale company, in order to control the number and the handling of exhibits.

Judges and directors of the show were surprised at one outstanding revelation; namely, that craftsmen, who all day engage in jobs demanding extreme precision, go right ahead and spend their spare time in exactly the same pursuit. To be statistical, the third largest classification of exhibitors, representing no less than 13 percent of the exhibitors, was this "extension of the job."

One of the exhibits at the hobby show; rifles made by a machinist

Chiefly confined to the tool makers, this feature brought out the fact that these men stay at their benches after working hours and use the company equipment to produce bevel protractors, sine bars, telescoping gages, angle plates, spring threading tools, parallel clamps, layout plates, universal V blocks, planer gages and so on. The instruments were made as a rule to work to one ten-thousandth of an inch, and were tempered, carburized, hardened, and ground as required. Much amiable rivalry was noted among the tool makers to produce a more beautifully finished and more precise instrument than the next fellow. When the maker finishes his product, he likes to use it in his regular work.

Smallest A. C. Electric Plant

THE gasoline driven generator unit shown in the photographs has been designed especially for use where a light,

Above: Portable A. C. power plant.

Below: Close-up of motor-generator

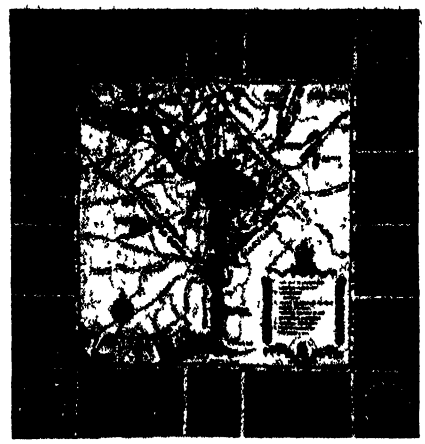
compact, and efficient electric plant is desired.

Though weighing only about 60 pounds, the unit may be used as a source of portable power for both long and short wave radiophone transmitters and receivers, sound truck amplifiers, movie projectors, electric drills up to one half inch, and other electric tools and appliances.

For stationary installation, the base is fitted with suitable bolting down lugs and exhaust fittings to fit standard one inch pipe.

In designing the unit, every effort was taken to produce a machine which would be simple to operate and with which standard 110-120 volt, 60 cycle, A. C. equipment and appliances might be used without any auxiliary apparatus.

The generator, which is the secret of the unit's performance, is of unusual design. The most noteworthy fact about the Weco unit's system of voltage regulation is that



Handkerchief map described below

it is entirely built into the generator and requires no mechanical parts, resistances, choke coils or any other auxiliary apparatus.

In mechanical construction the generator resembles the type used in large power plants throughout the world. The only moving part is the rotating field to which field current is conducted through two brushes. Since the field voltage is only in the neighborhood of thirty volts, the difficulties encountered by using higher field voltages are eliminated. The armature, which is stationary, carries one winding for field excitation, one for voltage regulation, and one for power output.

The gasoline motor used on this unit is of the two-cycle type, simple in construction and operation and very reliable. An improved air cooling system insures adequate cooling for both engine and generator, and a sensitive governor maintains proper engine speed.

The aluminum base of the unit contains a gasoline tank and a filter compartment in which is enclosed a filter to eliminate radio interference from the generator brushes. For convenience in making electrical connections to the generator, a conventional type of convenience outlet is located in the aluminum base.

The entire magneto and ignition system of the engine is shielded to prevent radio interference.

The complete unit is 18 inches long, 12 inches wide, and 12 inches high and may be easily carried on a packboard. It is suitable for operating 110-120 volt 60-cycle A.C. equipment not requiring more than 350 volt-amperes or for lighting up to five 100-watt Mazda lamps or equivalent.

Handkerchief Maps of Washington

THE United States Government having decreed that this year shall be known as National Park Year, the Handkerchief Maps of Washington, now made available by the American Civic Association, a private organization, are very timely.

The purpose of these maps is to raise funds for the building of the George Washington Memorial Parkway. This 14-mile stretch, when finished, is to become another National Park, thus bringing to a successful conclusion George Washington's dream of a through right of way along the Potomac River, from Mt. Vernon to Great Falls, and at the same time preserving forever the natural beauties of the Falls.

From an historical standpoint, it is interesting to know that in 1792 and 1796 George Washington printed handkerchief maps of "the New Federal Town" as Washington was then called, in order to promote the sale of dwelling sites there. One of each of these original maps now hang in the Congressional Library.

The American Civic Association, needing land for the continuation of the Parkway, adopted George Washington's idea. The original Pierre L'Enfant map of Washington, contained in the original handkerchief maps, has been used as a basis on which to depict, on the present maps, the growth of the nation's capital since that time.

These maps have many uses; they may be framed, or made into bags, quilts, luncheon sets and aprons. Size 28 inches square; material, fine lawn; colors, terra-cotta, plum, brown, green, and red, on a white background. Further information may be had from the American Civic Association, 901 Union Trust Building, Washington, D. C.

Science Course for Professional Gardeners

HORTICULTURE in the United States has been unduly neglected as a profession, largely because of the lack of opportunity for gardeners to gain a knowledge of the sciences underlying their work. European institutions have long given specialized training to men working with plants, the completion of which is sometimes equivalent to a college degree in any other profession.

The first attempt at offering scientific training to gardeners in the United States is being undertaken by the New York Botanical Garden, which on October 1 is opening the third year of its Science Course for Professional Gardeners. While not yet as extensive or as intensified a course as that offered, for instance, at Kew, upon which it is modeled, this course is giving a valuable education to gardeners, both old and young. While the older men, most of them superintendents of large estates, are taking the work chiefly as a means of strengthening their foundations in their profession, to the younger men it means a definite chance for advancement. And as they advance, the practice of horticulture in America gives promise of advancing under their direction. It has hopes of rising from a mere trade to the rank of a profession.

Subjects taught to the gardeners are those branches of science which most directly affect their work—systematic botany, morphology and plant physiology, soils and fertilizers, entomology, plant pathology, and breeding. Classes meet every Monday night for two terms of 12 weeks each.

Diet Dislodges Lead from Body

A SPECIAL diet which was helpful in treating cases of lead poisoning was reported by Dr. Irving Gray of Brooklyn at a meeting of the American Medical Association. Lead poisoning is one of the greatest of all industrial hazards.

The diet is one which contains much phosphorus and little calcium. It helps in getting the lead out of the body, actually dislodging it from the tissues where it has

been deposited. The diet treatment is based on the discovery of American investigators that the storage of lead in the body tissues is favored by a high intake of calcium, while elimination of lead is increased by lowering the calcium intake.

Dr. Gray reported four cases of persons who had worked with lead for only a few months. "Deleading" by diet and medicine removed the lead from their systems in two weeks. In three other cases so much lead had been deposited that it required three or four courses of treatment to "delead" the patients.

Too rapid "deleading" may prove dangerous. Consequently Dr. Gray advises that the treatment be carried out in a hospital.

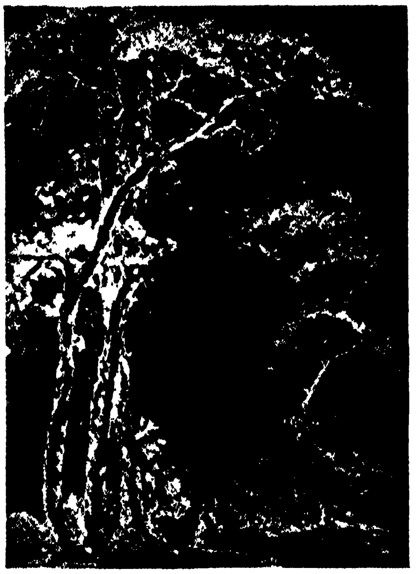
The diet includes such foods as eggs, whole wheat bread, lamb chops, liver, green peas, pineapple juice, baked potatoes, and halibut, which all contain large amounts of phosphorus. Phosphorus, it has been found, literally pulls the lead out of the tissues and eliminates it from the body.

All milk is omitted from the diet because milk is the most important dietary source of calcium.—*Science Service.*

Midnight Paintings

FLUORESCENT paint is becoming popular. Even fan dancers are using it now. The fans are thus made luminous in the dark—the dancers invisible.

Paintings which glow in the dark when invisible ultra-violet rays are thrown on them are called fluorescent. They emit a



Example of a "midnight painting"

weird, unearthly light, akin to phosphorescence, and are being used for murals. A photograph of a wall painting of this kind, by the Switzer Brothers Ultra Violet Laboratories of Berkeley, California, is reproduced. In daylight the surface on which the original of this was painted appears to be white. At night, when illuminated as described above, the wall disappears and the painting appears in soft green.

Fluorescent paints are used on stage costumes and scenery, for painting any kind of pictures, in advertisements, and on many other objects. They are available in different colors.

Fluorescence is simply absorbed light which happens to be of a wave-length that is invisible to the eye (ultra-violet), transformed by the substance it strikes into light of a longer wave-length which is visible to the eye. Phosphorescence is akin to fluorescence, and both are forms of luminescence.

Carbon Black Production

AMERICAN manufacturers produced 269,325,000 pounds of carbon black in 1933. Made by burning natural gas and collecting the "soot," carbon black manufacture consumed about 12 percent of the natural gas used in this country last year. It takes 1000 cubic feet of natural gas to yield 1.44 pounds of carbon black.

According to the United States Bureau of Mines, the carbon black industry has moved steadily westward for a number of years, but the center of production took a step eastward in 1933 when Louisiana showed the largest increase of any of the major producing districts. Although the Texas Panhandle increased production only 7 percent over 1932, it produced 190,356,000 pounds or 71 percent of the total output for 1933. Average value of carbon black at the plants, which has declined steadily since 1928, showed a slight gain in 1933, being 2.77¢ per pound, compared with 2.75¢ in 1932. The total value of carbon black produced in 1933 was 7,449,000 dollars. This compares with 6,664,000 dollars in 1932.

U. S. Has 43 Percent of World's Radio Sets

THE United States not only leads the world in its number of radio sets, but comes near having more than all of Europe.

Statistics just compiled by the United States Department of Commerce give the radio census of the United States as 18,500,000 sets as compared to a world total of 42,540,239. Europe has 18,594,605, total.

16 Bales of Cotton for Conveyor Belt

THEY make them big in Passaic, New Jersey. Witness our illustration which shows one of the world's largest belts.

Built for a limestone plant by The Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc., this single-

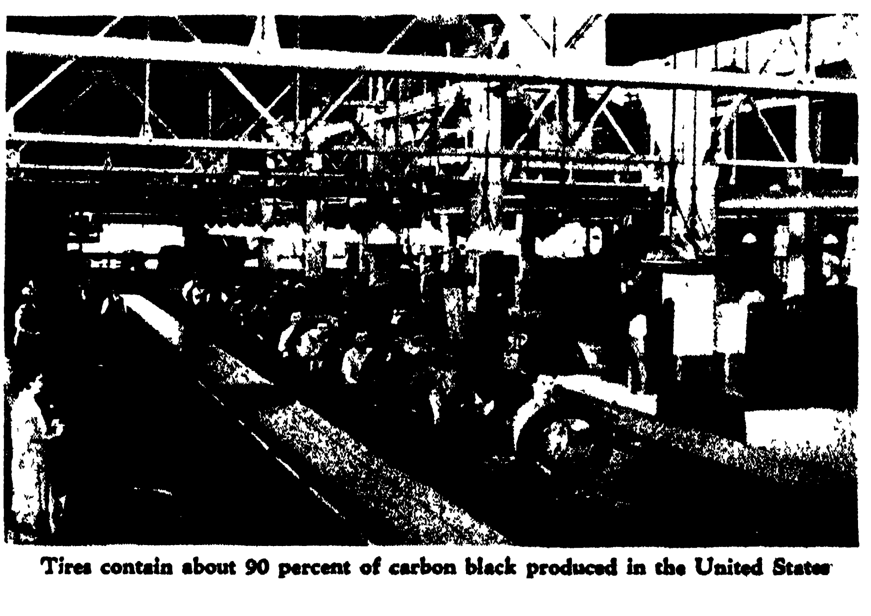
A belt 1291 feet long, made from 16 bales of cotton, weighing 11 tons

piece rubber conveyor belt is nearly a quarter of a mile long (1291 feet) and four feet wide; over 5000 square feet of tough rubber. It is seven by nine ply heavy duck construction with a ¼-inch reinforcement on top and a 1/16-inch reinforcement on back.

Sixteen bales of raw cotton were used in making it. It weighs 11 tons and will deliver 1500 tons (136 times its own weight) of crushed limestone every hour.

America, Do You Want Your Elms?

IF America wants her elms, apparently she will have to exterminate the Dutch elm disease which has invaded an area of some 3000 square miles in New Jersey, New York, and Connecticut. The greatest concentration of the disease is still confined to an area of about 1700 square miles. Up to July 31, approximately 6500 trees were known to be infected. Of these, about 4000 are still standing and 2500 have been removed by federal, state, municipal, and private means.



Tires contain about 90 percent of carbon black produced in the United States

Elm trees estimated to be from 75 to 150 years old which two weeks ago showed no external signs of the disease today stand dead. Nothing can now be done except to remove and burn them. Highly prized elms on which the owners have spent hundreds of dollars for surgical work in an effort to save them from decay and other troubles are killed almost overnight by the Dutch elm disease.

The disease was first found in this country in 1930. It has been known in Europe for approximately 16 years, during which time it has proved very destructive.

A diseased tree cannot be treated; it must be removed and burned. It is believed that a small beetle which infests the trees carries the disease to uninfected trees. If diseased and beetle-infested trees are not removed and immediately burned, the beetles leave the infected trees and move to uninfected trees. Thus the disease is rapidly and widely spread.

The indications are that unless a vigorous, consistent program is carried out to remove and burn every infected tree, the elms of America may follow the American chestnut to almost complete destruction by disease. All the United States Department of Agriculture can do with the limited funds at its disposal is to conduct scouting operations to find the diseased trees and co-ordinate the eradication activities, although some money is being spent to take out trees which are obviously most dangerous to areas not yet infected and which otherwise would not be removed in time. If individuals, cities, counties, and states will at once undertake and aggressively carry out the right kind of a program of eradication, there is a fair chance to eradicate the disease. Failure to do this probably means dedicating the elms of America to disease and death. The question is: Do you think enough of your elms to save them?

Search for Harmless Morphine

TAMING morphine to be the perfect servant of medicine, without the dangers of drug addiction and poisoning which now accompany its use, seems within the realm of possibility, as a result of co-operative work between the Universities of Michigan and Virginia and various Government bureaus, report Drs. Charles W. Edmunds and Nathan B. Eddy, of the Michigan Medical School.

Ridding morphine of its habit-forming and toxic properties is proceeding as a complicated chemical juggling of the parts of the morphine molecule, said Dr. Edmunds and Dr. Eddy. Like most substances of organic origin, morphine is a very complicated union of carbon, hydrogen, oxygen, and nitrogen. The morphus molecule is pictured as consisting of a nucleus of phenanthrene, a common coal-tar derivative, to which are attached several "chains" and "rings," each consisting of different atoms in varying proportions. These chains and rings and their exact attachment to the nucleus furnish the chemical explanation of why morphine acts as it does in the body.

Knocking some of these chemical hangers-on from the nucleus, or "muzzling" them with other chemical groups, produces new derivatives which affect the body differently from the original product. This part of the work has been done by University of

(*Please turn to page* 213)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

ONE night last summer James T. Barkelew and Byron L. Graves of Los Angeles, with Russell W. Porter of Pasadena, went off on a jaunt in the California hills, taking along with them Barkelew's small reflecting telescope. Porter was so impressed by a slow-motion wrinkle which Barkelew has applied to a simple telescope that he made the sketches shown below. The wrinkle consists of a thumbscrew working in a half nut, and the virtue of it is that, while the springiness of the arm and a piece of spring brass to which the nut is attached holds it to whatever part of the screw it is placed against, it can be lifted off and shifted at once without a second's fuss. Barkelew has this wrinkle on both his R. A. and declination motions, and he writes that "if anyone is foolish enough to want to make one, I can tell him how this one can be improved without making it too fussy." His address is Great Republic Life Building, Los Angeles. This looks like a wrinkle well worth copying—study it over. Barkelew is the man who is interested in automatic photo-electric telescope guiding and who described his ideas on that subject in the August number.

ON the opposite page at the bottom you will see a picture of a grinding machine made by Clark B. Hicks of the Amateur Telescope Makers of Indianapolis, of which V. E. Maier, 1306 Parker Avenue, that city, is secretary. Maier writes that Hicks' machine works just as smoothly as the best steel ones, although it is made entirely of wood with babbitt bearings. All the rotating parts are below the top of the table. The originality of this piece of work is manifest in the photograph: the lever at the right-hand corner, for adjusting the length of the stroke while running, the "model T" drag link with ball and socket joints at either end, making the mirror "full floating," and the improved Lee ratchet eliminating all bevel gears and driving rods on the link. By adjusting the transverse arm the equivalent of an elliptical stroke can be produced.

WE learn that the Corning Glass works has supplied a 24-inch disk of Pyrex to the College of Puget Sound, Tacoma, and that the Amateur Telescope Makers of Tacoma will grind, polish and figure this mirror. Alan R. Kirkham will have charge of this job, with George Croston assisting. More amateurs doing professional work!

HERE is A. W. Everest's latest revision of the previous revisions of the revised methods of using HCF laps, complementing or supplanting Part VIII of "Amateur Telescope Making." Everest writes:

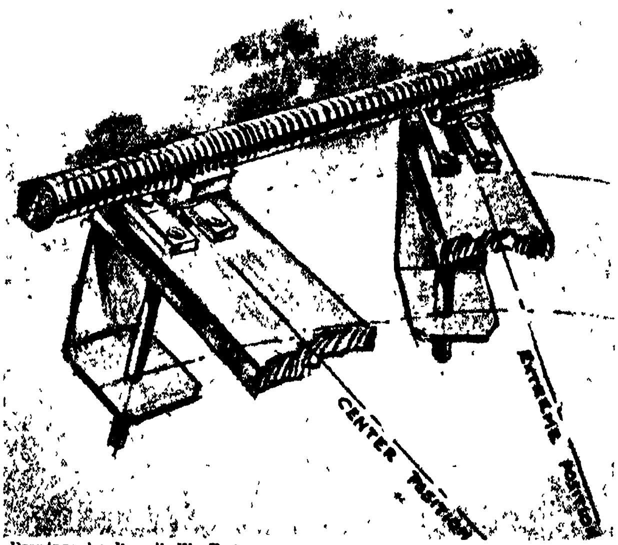
"We use HCF on the tool for bringing to a complete polish, paying no attention to the figure until then. Embed the HCF in a very thin layer of soft pitch—pitch in which at room temperature one pound pressure with the thumb nail will make a quarter inch dent in one second instead of the five seconds usually allowed for a pitch tool. The pitch layer should be thin enough so that the HCF will sink right through to the glass and become *unyielding*. It will maintain contact by *wearing*. After forming, dash on some water and rub all over lightly with a cake of Ivory soap. Then work the mirror back and forth a few times to produce a fine, bubbly suds before applying the rouge and water mixture; otherwise the rouge won't stay in place.

"The polishing action of the HCF tool must be kept in mind if you are to maintain top speed. Practically no rouge granules become embedded in the surfaces of the facets, as in the classical pitch tool. It is the wedge of rouge granules that forms at the *edge* of each facet during each individual stroke that does the work. On the reverse stroke this wedge breaks away and another forms on the opposite side of each depression--and so on, back and forth. From the above you can see that only a small amount of the rouge in the mixture can be effective. Surplus rouge is worse than useless, as it piles up to the extent that it rolls over the facets, wearing them down too fast. A heaping teaspoon in half a glass of water is sufficient. If you can look through the mirror and see all the facets as you work, all is well.

"For the final figuring I recommend a pitch tool."

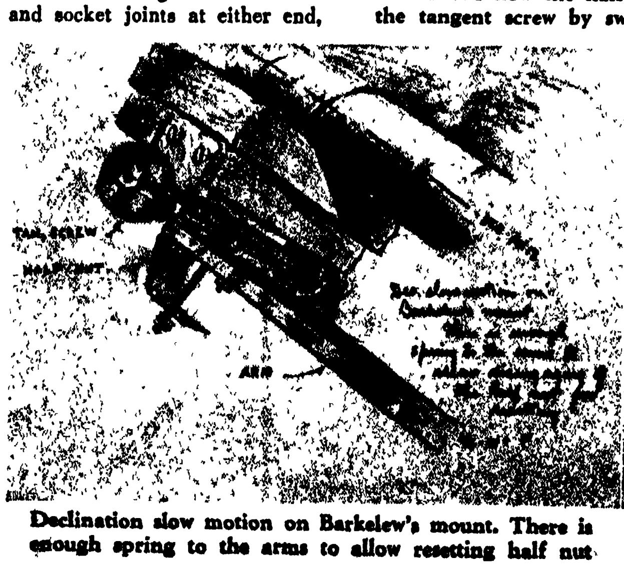
Norman Shillinger, 403 Commerce Street, Wilmerding, Pa., finds that cutting channels in a lap under water will prevent chipping the lap—like cutting glass with shears under water.

HERE is a letter received from Clayton R. Tinsley, president of the Tinsley Laboratories



Drawings by Russell W. Porter

This shows how the half nut always stays engaged on the tangent screw by swiveling in the slots provided



Declination slow motion on Barkelew's mount. There is enough spring to the arms to allow resetting half nut

This illustration is virtually a continuation of the one to the left—same declination axis and same arm, except turned a bit

in Berkeley, California (3017 Wheeler Street):

"Tinsley Laboratories desires to offer the following contribution: We note that not more than five percent of mirrors sent to us for silvering are fully polished. The following test, used by us on our own work, might be a revelation to many.

"Take a small reading glass or other simple lens and, using it as a burning glass, throw a bright spot upon the supposed

Declination arm attached to a mount like that in A.T.M., page 29

polished surface. Either an electric light or the sun may be used, though the latter is much the better. A surface which seems quite fair using a magnifying glass in the usual manner will now appear as a gravel bed even to the naked eye. If the test seems too drastic, try it out on a professionally polished surface, such as a B. and L. prism. If the prism surface is clean and free from grease, even the most intense 'burning glass' spot can scarcely be detected by front face reflection."

At the risk of being lynched, your scribe will add that he is suspicious that many of the short, two- and three-hour polishing jobs

Grinding machine—Hicks

he constantly hears of will not pass this test. Please accompany future claims with affidavits sworn on A.T.M.

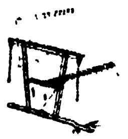
The old chestnut about local figuring with the ball of the thumb is up again for discussion. We wrote to J. W. Fecker for his opinion. His reply was: "This is definitely one of those myths the origin of which nobody knows, but it nevertheless persists." In spite of this we frequently hear that this was the lost, secret method used by the great professionals. We are from Mo.

RECENTLY PATENTED INVENTIONS

Conducted by A. P. PECK

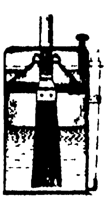
Porch Glider Construction

Patent Number 1,962,917, Milton B. Smith. An easily handled frame for porch and lawn gliders of the type having a back and seat so supported that they swing between upright frames is one of the main objects of this invention. This particular type of frame construction makes it possible to assemble or disassemble the frame of the glider without the use of bolts and nuts, and to erect or knock down the frame conveniently and without the use of special tools or connecting devices. When this glider frame is assembled, parts of it are rigidly fastened together by riveting or other suitable means while other parts are so arranged as to be easily connected through locking joints. The accompanying drawing shows one end of such a glider frame in which the horizontal bar connecting the two vertical supports holds them rigidly by means of notches in the ends and swinging arms which are securely locked into position by means of latches engaging lugs located at the proper points on the vertical frames.



Paint Brush and Container

Patent Number 1,959,441, Harry Oscar. This invention relates to brushes as used in applying such liquids as paints, varnishes, and lacquers, and the receptacles in which the brushes are placed when not in use. One of the objects is to provide a practical means to catch and retain all drippings from the brush during use and thereby prevent not only the waste of material but also soiling the hands of the user. The receptacle which is a part of the invention is so designed as to be airtight and to contain both the liquid and the brush when not in use, thereby preventing the brush from drying out and maintaining it in condition for instant use. In the airtight container is formed a "vacuum" trap. The partial vacuum can be released by turning a needle valve provided.

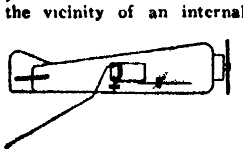


Typewriter Key

Patent Number 1,967,721, Garry W. Munson and Eugene Hebel. The present invention relates to improvements in spring actuated keys for typewriters adapted to be fitted to the keys of existing machines. One object of the invention is to provide a very compact key, the upper member of which is so supported that it can slide telescopically within the lower member, the two being normally supported by means of a spiral spring. Another object is to provide a key of this type which is simple in construction, efficient in operation, and economical to manufacture. The drawing herewith shows the general design, in cross section, of this invention.

Aerial System

Patent Number 1,967,604, Harold H. Beverage. Various systems have been proposed in the past to eliminate the radio interference set up in the vicinity of an internal combustion engine such as in the case of an airplane. These systems have taken the form of shielding, and filters composed of inductances, capacities, and so forth. These systems are not always satisfactory because of various drawbacks, and it is the purpose of the present invention to produce an interference elimination method which will make possible satisfactory radio reception under the stated conditions. In this case a trailing aerial of conventional design is used, as shown in the diagram, while another wire is installed to pick up the disturbances and feed them into the radio receiver. Here a bridge circuit is provided in which the disturbing currents are cancelled out. This is accomplished by feeding the two picked up interfering currents into the bridge circuit out of phase. Thus the interfering circuits will not continue into the receiver and ordinary reception can be carried on with a minimum of difficulty.



Preserving Proof of Invention

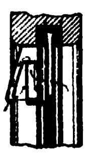
EVERY inventor who is working on a device which he contemplates patenting should first prepare sketches and a description of his invention, which should be dated and witnessed by at least two persons. The inventor has thus established the date of his disclosure, and such evidence should be deposited in a safe place from which it may be produced when needed.

When an invention has been completed, it is advisable to file an application for patent without delay. However, we realize that many inventors today do not have sufficient funds to meet this expense, nor have they safe places in which to keep their disclosures. Therefore *Scientific American* will undertake to act as a depository for such documents. These will be held in safekeeping for two years (unless withdrawn by the depositors) and then destroyed without opening.

To take advantage of this offer, place your papers in a sealed envelope endorsed with your name and address and marked "Not to be opened." Then enclose this in another envelope addressed to A. P. Peck, Associate Editor, Scientific American, 24 West 40th St., New York, N. Y., and mail. —*The Editor.*

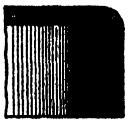
Ventilator

Patent Number 1,967,504, John J. Gaughran, Jr. and Edward Gaughran. It is the purpose of this invention to provide a ventilator for railway cars, buses, and automobiles which can readily be installed in connection with existing windows or similar openings. The particular feature of the invention, as shown in the drawing, consists of the arrangement of a trough-like baffle plate mounted within a hood which will effectively prevent drafts within the compartment while at the same time will freely permit foul air to be exhausted from the interior. The movement of the vehicle in which this ventilator is installed creates a suction which readily draws the foul air from the compartment, the trough-like baffle plate preventing the outside air currents from creating a draft within.



Brake Drum

Patent Number 1,966,130, Raymond J. Norton. Several things are to be desired in a brake drum such as those used in automobiles. The interior surface should have a high coefficient of friction and at the same time should be wear-resistant. The drum should be capable of dissipating heat as rapidly as possible, and should be resistant to corrosion. The present invention has as its object to provide a brake drum of composite structure which will have all of these desirable qualities. The brake drum is made of a material such as low carbon steel, formed in the usual manner. Then the interior surface is subjected to a case-hardening process so as to render this portion of the drum harder than the remainder. Then the exterior surface may be treated so as to increase its resistance to corrosion and also its heat emissivity. This is done by forming on the surface a skin or coating of aluminum oxide by means of anodic oxidation.

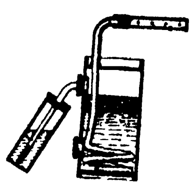


Sadiron

Patent Number 1,965,746, Michael N. Matveyeff. One of the dangers of using ordinary electric sadirons is that if they are left on the work unattended for any appreciable length of time there is a possibility of burning the material being pressed. In the present invention means have been provided for eliminating this trouble. Springs and a movable weight are so provided that when the hand of the operator is removed from the handle of the iron the handle will spring backward, shifting a movable weight and causing the working face of the iron to be lifted from the material being pressed and held upward at an angle. The drawing herewith shows how this is accomplished, a latch being provided at the forward end of the handle, which latch closes only when the operator's hand is on the iron. The movable weight consists of a quantity of mercury contained within the handle. When the iron is in its tilted position, the current remains on.

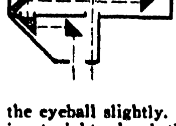
Blow Torch

Patent Number 1,966,252, Lester L. Lather and Arthur Goddu. One of the serious difficulties with automatic blow torches, as ordinarily constructed, has been the inability of the torch to operate at maximum efficiency when the torch is tilted to an unusual angle such as may be required by some particular job. When this happens the alcohol or other liquid fuel rushes into the space normally occupied by the vaporized gases when the torch is upright and so causes a diminution and in some cases an actual extinction of the flame. In the present invention a plug or barrier is inserted in the fuel chamber, as shown in the drawing, through which the wick passes. Thus the liquid fuel is retained in position in the bottom portion of the tank and space is reserved in the upper part for the volatilized gases. Other improvements in the construction of automatic blow torches are described in detail in the patent specification.



Camera

Patent Number 1,967,279, Oskar Barnack. Where distance meters are used on ordinary cameras, it is usually necessary for the operator to move his line of vision from the distance meter to the view finder before he can complete his exposure. In the present invention a system of prisms and mirrors is so arranged that the operator can use both the view finder and the distance meter or range finder merely by moving the eyeball slightly. As shown, one line of vision is straight ahead through the view finder. By shifting the line only slightly to one side, vision is through the prisms and mirrors of the range finder. Thus it is possible to make accurate exposures with a minimum of inconvenience.



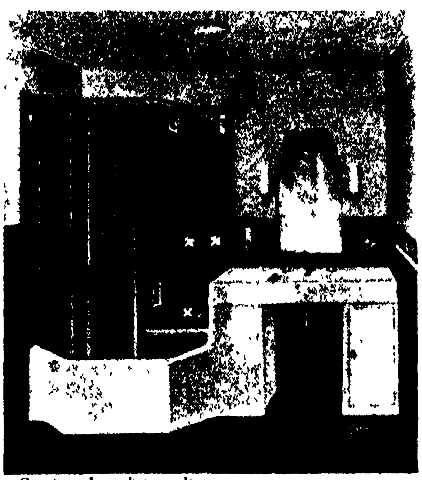
The above information has been taken from copies of patent specifications. No further details are available except as can be obtained from such specifications.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 209)

Virginia chemists who have produced dozens of different compounds, many of them new to chemical literature.

Next, these morphine derivatives are sent to the University of Michigan, where their action is studied on animals and compared with morphine. Most striking so far is a compound which, although only three times as toxic as morphine, possesses pain relieving qualities 10 times as great, and 30 to 40 times the general depressant effect. This derivative, dihydrodesoxymorphine-D, might be given in small doses with greater general effect and less toxic danger than a large dose of pure morphine. It was made by removing one of the side chains from the phenanthrene nucleus and replacing it with hydrogen. Certain of the new compounds, which have been made and which appear most promising for medical uses, are being tried out on human patients to see whether or not they possess addicting properties.



Courtesy Lavashower, Inc.

This space-saving unit for modern bathrooms may be installed in a space no larger than five by seven feet, yet it provides a complete lavatory and bath tub with shower. The tub is recessed under the lavatory, giving all the advantages of a standard tub. The other support of lavatory is a towel cabinet

Yellow Glass

INDIUM, the rare metal with which scientists are just becoming acquainted, was so named because its discoverers found that it produced indigo blue lines in its spectrum. It seems odd that a substance so historically associated with the color blue should find a new and promising use in coloring glass yellow. William S. Murray, of Utica, New York, who is devoting himself to the study of this little-known element in an effort to find commercial uses for its unique properties, has recently found that indium sesquioxide imparts a beautiful yellow color to glass, ranging from light canary to dark tangerine-orange, depending upon the amount of indium used.

Heretofore, the production of yellow glass

has depended on compounds of uranium, cerium, and titanium. The uranium hydrate has a greater coloring power than any of the usual compounds. Cerium and titanium have been used together in rather substantial amounts but the color is lighter than is desired. Uranium gives a canary yellow color.

So far as has been determined, indium sesquioxide gives a more intense yellow color than any of the other oxides used. One-half pound imparts a beautiful yellow to 1000 pounds of glass-forming materials. This amount is about one seventh that of the metallic oxides previously used for coloring glass yellow.—*A. E. B.*

European Shelterbelts Help Modify Climate

PRESIDENT Roosevelt's plan for the establishment of a vast shelter belt of trees across the drought-stricken Great Plains, while representing by far the largest reforestation project of its kind ever undertaken in this country, is not the first attempt ever made to modify climatic and agricultural conditions by tree planting, according to the Forest Service, United States Department of Agriculture.

One of the most famous large-scale tree-planting projects was begun more than 60 years ago on the steppes of southern Russia, where conditions are in many ways similar to those of the prairie regions of this country. Protection forest strips were planted over thousands of acres as a defense against the "black dust storms" caused by the heavy winds which raged over the plains. Studies show that the forest belts reduce the average wind velocity between the strips by 35 percent during summer and about 20 percent during the winter. Evaporation of moisture between the strips, as contrasted with open prairie areas, is reduced by 30 percent, and yields of grain in a typical dry year were more than a quarter ton per acre greater than in the open prairie.

The Landes region of France is another striking example of the conquest of man over the inimical forces of nature. Forest planting here has reclaimed thousands of acres of waste lands and has vastly improved living conditions. Large-scale forest plantings have also been carried on in more recent years in Italy and Hungary for the reclamation of waste lands and the prevention of erosion.

A notable reforestation project was begun by the Forest Service some 30 years ago in western Nebraska, and a green, growing forest, already yielding some timber, now covers thousands of acres of what were formerly barren sandhills. The area is now the Nebraska National Forest.

The Forest Service has made extensive studies of existing wind-break plantings in Nebraska and Kansas, and has found windbreaks effective in reducing surface velocity of the wind to a distance at least 20 times the height of the trees. Their effect in conserving soil moisture, preventing movement of the soil by winds, and in increasing crop yields has also been noted.

Dinitrophenol Dangerous

THE "reducing racket" has a group of new and dangerous drugs, dinitrophenol and related compounds. Racketeers are selling these drugs in fat reducers in spite of reports of deaths caused by their compounds, says W. G. Campbell, Chief of the Food and Drug Administration. "Reducing agents containing these drugs," says Mr. Campbell, "have sprung up like mushrooms all over the country, and are endangering the lives of patrons. The Federal Food and Drugs Act has no jurisdiction over products of this type, dangerous though they may be. All that the Food and Drug Administration can do is to warn the public that these compounds are dangerous."

Clinical evidence shows, Mr. Campbell said, that these drugs act by increasing the metabolic rate. This amounts to a speeding up of the body processes, resulting in a destruction of the tissues, including fat, to provide fuel for the accelerated metabolism. Common symptoms are increased temperature, pulse or respiration, or copious sweating. In particular, Mr. Campbell warned, these drugs should not be used by individuals suffering from chronic rheumatism, alcoholism, tuberculosis, or diseases of the

A view of the three-inch nozzle used in sluicing off the overburden on a quarry at the site of Norris Dam on the Clinch River, Tennessee. Water was used at a pressure of 100 pounds, and the overburden was washed off ***(Continued at right)***

heart, liver or kidneys, as poisonous and otherwise harmful effects are even more likely to manifest themselves. There is also some evidence that they may cause profound disturbance of the blood-forming organs.

These drugs, in common with many others, may serve a useful purpose when the dosage is properly adapted to the needs of the individual patient, provided there are no contra-indications to its use. Proper dosage and indications for use, however, as well as prompt discovery of toxic effects, can be determined only by a skilled physician. Furthermore, there may be unexpected harmful effects that are not disclosed by the first tests. Such effects can be determined conclusively only after extensive trial and use, in addition to the tests which should in all cases be made before the preparation is offered to the public.

Mercury-Made "Sunlight"

MERCURY, the liquid metal which we knew as the fascinating quicksilver in childhood days, is responsible for a new light source that is expected to exert considerable influence on artificial lighting practice of the future. This new light source was developed in the engineering laboratories of the Westinghouse Lamp Company and is known as the high-pressure mercury lamp.

The principle of producing light by bottling metallic vapors and then passing an electrical charge through them was the basis of the sodium lamp invention by the Westinghouse engineers in 1917. It was not until 1932, however, that suitable glass, which would withstand the deteriorating chemical reaction of sodium vapor, was developed. The success of this research paved the way to the high-pressure mercury vapor lamp.

Perhaps the outstanding feature of the high pressure mercury lamp is its high operating efficiency. The use of vaporized mercury as a source of light is in itself nothing of revolutionary character. For a number of years, low pressure mercury lamps have been in use, but their efficiency is on the order of 15 to 20 lumens per watt. In the new lamp mercury in an inner tube is vaporized by an electric arc and the pressure kept relatively high through the maintenance of a high operating temperature. In this way, it is possible to obtain efficiencies of 35 to 45 lumens per watt. The resultant light is distinctly bluish-white in color instead of the bluish-green of low pressure design.

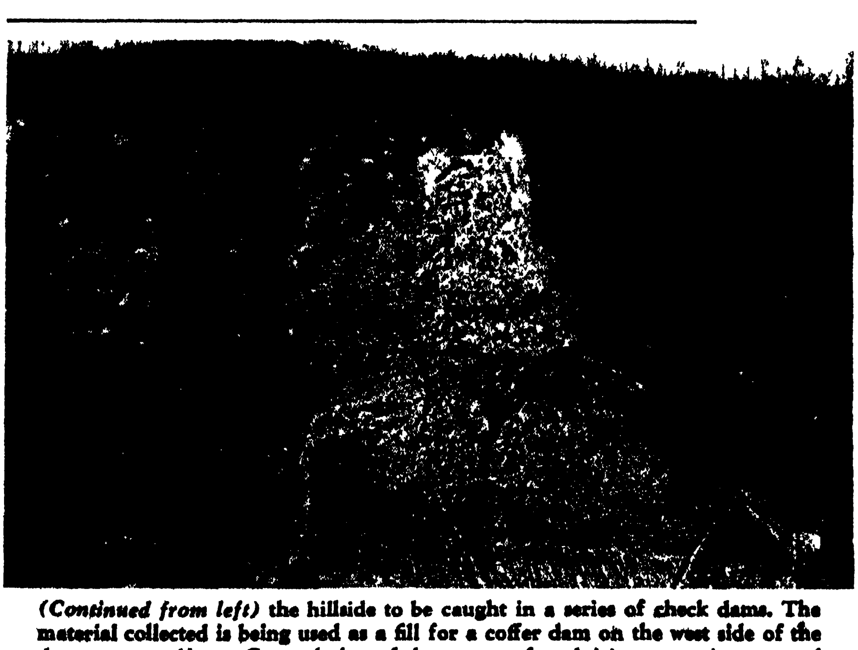
The glass inner tube, which is approximately 7½ inches long and 1⅜ inches in diameter, contains a drop of mercury which is vaporized by the electric arc. There are two electrodes at each end of this inner tube. The arc is established between these electrodes. One of the reasons for constructing the lamp with two tubes was to provide a means of conserving heat. The outer tube or the apparent lamp bulb acts as a jacket. In the space between these two bulbs is nitrogen gas at approximately one half atmosphere pressure. This gas prevents arcing between the metal parts which hold the inner tube firmly in the lamp bulb. The ends of the inner tube are coated with a gold paint which reflects heat back into the inner tube and further contributes to a constant high temperature.

The electrodes in the ends of the inner tube are coils of tungsten wire. Trapped in each coil, however, is a small slug of a special chemical compound which supplies a copious flow of electrons from the time the lamp first begins to operate.—*A. E. B.*

Wiley Post's Altitude Suit

THE indomitable and skilful Wiley Post is planning to fly in his globe girdling airplane, *Winnie Mae*, from London to Melbourne, Australia, in two days, in an attempt to capture the first prize of 10,000 pounds in the MacRobertson International Air Race. Post plans to make the England-Australia flight at an altitude of approximately 30,000 feet, and with his highly supercharged engine and Smith controllable pitch propeller hopes to attain a speed of 300 miles per hour in the thin air of this great height.

Of course the equipment needed for this feat is of considerable complexity. Not the least part of this will be a special altitude



(Continued from left) the hillside to be caught in a series of check dams. The material collected is being used as a fill for a coffer dam on the west side of the dam proper. *Above:* General view of the quarry after sluicing operations started

suit. On such a long journey it is of course impossible to rely on the usual oxygen supply which pilots use for altitude flights of comparatively short duration. Wiley Post has hit on an entirely new idea in this altitude suit of his, which is shortly to be tested in a practice flight.

The flying suit has been developed by the Goodrich Rubber Company, who are also responsible for the well known airplane "de-icers." We are indebted to the engineers of this company for a first hand description of the suit.

A dural helmet, similar to those used by divers, is attached to a rubberized silk fabric shirt. Gloves are continuous with the sleeves; pants of the same material are attached to rubber boots.

The helmet is made with a fixed glass visor, with a mouth door which can be opened at will, and which when closed is sealed with sponge rubber. At the top of the trousers is a metal ring to which the fabric is cemented so as to form a seal. The skirt of the shirt is sealed around the ring at the top of the trousers by means of a separate split ring.

The suit is inflated by a line from the engine supercharger. There is also a separate line carrying warm air, which is heated by passing through a copper coil wrapped around the exhaust stack. The flier can lead this hot air into his helmet and remove any frost which may collect at high altitude. Another connection of the hot-air line will provide warm air for the suit itself. The suit is designed so as to withstand a pressure differential of five pounds per square inch between the inside and the thin air of the outside atmosphere. The gloves at the ends of the sleeves are made of rubber and are tight fitting. Roughly, the principle of an inner tube casing has been followed in the design of the suit.

At the knees and elbows there is an elastic rubberized fabric material which fits snugly but affords freedom of limb movement.—*A. K.*

A Real Golf Practice Device

THE royal and ancient game of golf has been played for more than four centuries without a satisfactory practice device that enables John W. Duffer (or Mrs. Duffer and son John Jr.) to step up to a real golf ball in the privacy of their own home, hit said golf ball as hard as possible with a real golf club, and obtain registration of slice, hook, distance, and direction in a few feet of space. True, many attempts have been made to provide the ideal device, using complicated electrical and mechanical systems.

It remained, however, for John K. Stafford, an engineer of the General Electric Company, to invent Golf Register, which will accomplish the desired results in a simple manner.

Golf Register consists essentially of a ball harnessed to a leather strap encased in a collapsed rubber tube. The tube in turn is held inside an aluminum trough. The aluminum trough is pivoted at one end and forms both a friction device against pulling out of the rubber tube, and a direction indicator. A vertical stud driven through the center of the golf ball serves to tee up the ball for a drive. When hit, the ball flies forward, but is brought to rest within 12 feet of forward travel.

Slice or hook is registered while the clubhead is in contact with the golf ball, by the proportionate rotation of the ball in a clockwise (slice) or counter clockwise (hook) direction on the vertical stud. This registration is then preserved by "friction lock" principle. This is obtained by an extremely simple mechanical construction that locks the ball against further rotation on the stud, as the ball shoots forward and beats down violently against the ground. This friction lock is accomplished by the mushroom shaped head of the stud G, shown vertically mounted through the ball in the accompanying cut. When the stud is in the position shown in the cut, the golf ball exerts practically no pressure against the mushroom shaped head of the stud. Hence, the ball can rotate clockwise (slice) or counter clockwise (hook) on stud G while the clubhead is in contact with the ball, and the proportionate rotation of the ball into the slice or hook area on top of stud head G, indicates the severity of the slice or hook. The ball is then locked in this position, and is held by friction against further rotation, as the ball shoots forward and beats down violently against the ground in coming to rest.

Carry distance (flight in air of free ball) is registered by the amount of collapsed

The golf practice device, described above, in use

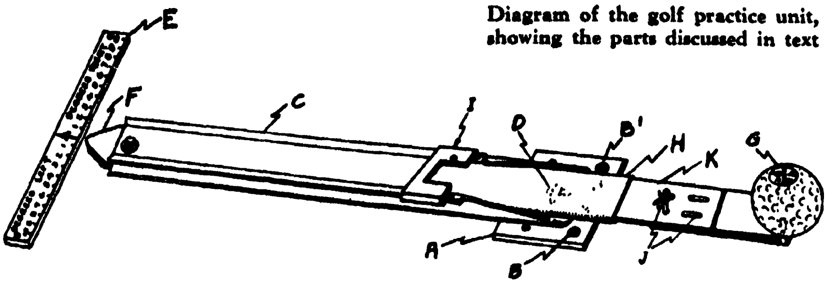


Diagram of the golf practice unit, showing the parts discussed in text

rubber tube H pulled out by the momentum of the ball straining forward against the backward drag of the rubber tube in the friction trough C. The inside bottom of the trough C is calibrated in multiples of fifty yards, to register the approximate distance that would have been obtained by a free ball. Direction of flight of ball as it leaves the tee is recorded simply by the "weather vane" action of the aluminum trough C which is so light in weight that it swings around to point toward direction of flight taken by ball.

Silica Black

SILICA black is the name given by C. A. Jacobson of West Virginia University to what seems to be a new chemical substance, developed by him. Silica black is made by mixing together finely divided coal and siliceous material such as diatomite. The mixture is heated in the absence of air to a temperature between 650 and 1100 degrees, Centigrade. The resulting powder is separated into three grades, the finest having a specific gravity of 0.25 and being composed of 18 percent carbon, 75.5 percent silica and 6.5 percent oxides, sulphides and silicides of iron, aluminum, and other metals.

Silica black has a high oil absorption, mixes well, and has good spreading quality; it therefore might be used as a pigment in paints, printing inks, and so on. It reduces metallic oxides at high temperatures. It adheres tenaciously to objects and might be used as a carrier for insecticides, wood graining, leather tinting, and so forth.—*A. E. B.*

Hazards in Economy

DON'T buy "gas savers," "grease absorbers," or "burner protectors." They don't save a penny; in fact, they usually cost more by increasing gas bills and many of them cause headaches, or worse effects of that stealthy and dangerous poison, carbon monoxide.

The National Bureau of Standards has conducted an investigation of a number of gadgets and appliances that were sold over the doorsill by salesmen who lauded them to the skies in extravagant claims of their value. The results of this research called for a warning against such purchases, which the Bureau issued.

All of the "gas savers," it stated, affected the operation of a satisfactory gas range in such a way as to increase the tendency to form carbon monoxide, which even in very small amounts is injurious to health. Although agents sometimes boasted of a reduction in gas bills as high as 30 percent, none of the attachments tested increased efficiency appreciably, while some of them considerably increased the amount of gas needed for certain purposes.

The "burner protectors," the report continued, keep the burners clean but do so at the expense of cooking efficiency. None of the water backs tested proved satisfactory while some of them caused the formation of carbon monoxide. Attachable solid tops and all the varied things which are placed in the flues tended to prevent complete combustion and to lower efficiency and were an actual menace to health. A flue is constructed by the manufacturer to be as small as possible and still allow complete burning of the gas, and when it is obstructed further to keep more heat in the stove or for any other purpose, a dangerous condition frequently results.

"The 'grease absorbers,'" scientists observe, "should be called grease diffusers, because they merely distribute the grease more uniformly around the kitchen. Those that are filled with steel wool or other material in such a way as to obstruct the passage of the flue gases may become dangerous."—*Science Service.*

Honey for Golf Ball Centers

WITH a golf ball that is literally a "honey," golfers ought to be able to register some "sweet shots." Experiments have shown that honey possesses several of the chemical requirements that fit it for use as a golf-ball center. Many substances have been tried as centers for golf balls but the ideal material for the purpose has not yet been discovered.

According to Arthur M. Maas, in *Chemistry and You*, honey is hygroscopic, or has a natural affinity for water, and so will not dry out. It is not explosive—some golf ball centers have been. It is non-corrosive—a center filling that burns if the covering breaks is distinctly not nice.

Besides these requirements, golf-ball centers must have the following qualities:

High density—the weight per cubic inch must be high so the ball will not be affected by wind, and will hold a true course.

Elasticity—this makes it bounce from the club, and gives liveliness.

Small change in volume with changes of temperature—the ball should act in nearly the same way on hot and cold days, and heat should not burst it by expansion of the center material.

Uniform viscosity, or "gooiness," determines the spin of the ball on hot and cold days.—*A. E. B.*

No Man-Made Device Starts or Stops Rain

MANY suggestions for stopping the severe drought of 1934 have come in to the United States Weather Bureau during this summer, just as many are received for stopping floods in times of excessive

rainfall. In fact, a single cause, the wide use of radio, is often advanced for both drought and flood. No device yet developed by man is of any practical value in starting or stopping rain, according to Dr. W. J. Humphreys of the Weather Bureau.

Nature's method of making rain, Dr. Humphreys explains, is first to get an abundance of water into the atmosphere by evaporation from water surfaces, ice surfaces, growing vegetation, and damp soil and then to squeeze it out by lowering the temperature.

Ordinarily there is enough moisture in the air to provide at least a moderate rainfall whenever Nature's machinery for its condensation into raindrops is working right. This machinery calls for the proper distribution and movement of air masses differing in temperature and density. In other words, when a normal movement of atmospheric "highs" and "lows" is interrupted and a relatively stagnant atmospheric condition is established and persists for a long time, drought develops, notwithstanding the fact that there may be enough moisture in the air to produce rain.

Electrical devices, sprinkling the clouds with dry ice, starting large fires, and setting off loud explosions, among the other rain-making schemes suggested, either do not work or cost too much for practical use.

All of the electrical schemes investigated by the Weather Bureau, Dr. Humphreys says, are utterly useless.

Sending cooling substances up into the clouds to cause rain, he adds, is about a century old. Even liquid air has been tried. This plan, however, is wrong in principle, and no rain has ever resulted from such practices.

The use of fire to produce rain was strongly advocated 80 or 90 years ago and this suggestion continues to bob up from time to time. This method, Dr. Humphreys says, is correct in principle, but the cost of a fire big enough to break a drought would be prohibitive.

Disposal of Distillery Waste a Problem

ALTHOUGH the sale of their product is legal, the distilleries are finding that the law of the land is directed against the disposition of their by-products. At one Illinois distillery, for instance, the Government refuses to permit the discharge of untreated waste into the nearby river, for the resulting stream pollution would be roughly equivalent to that from a city of a million inhabitants. Consequently, the distillery is installing industrial waste treatment devices, costing approximately 300,000 dollars. The expenditure is to be made for evaporators, additional dryers, and housing. The plant, with a rated capacity of 20,000 bushels per day, is to operate on half-capacity output schedule until the treatment plant is in operation.—*A. E. B.*

New Type Double-Glazed Window

A NEW type of double-glazed window, known as Thermopane, which substantially reduces heat loss through windows and prevents frosting in cold weather, is now being produced by The Thermopane Company, a subsidiary of Libbey-Owens-Ford Glass Company.

The product consists of two panes of glass so fitted to each window sash that a dehydrated air space is provided between and reduces the flow of heat and cold. The device, which has been applied successfully in solving problems of air conditioning, is expected to have a widespread effect in the construction of windows in new homes and buildings.

Building engineers also have found that the Thermopane principle, besides preventing frost formation, eliminates condensation on the glass of windows, unless the inside humidity is excessively high.

Several of the nation's foremost architects and builders, who have used Thermopane in new buildings designed by them, have indicated their confidence that the day of double glazing of windows in building definitely has arrived.

Tests conducted by engineers showed that the new principle saves about 50 percent of the usual heat loss through windows. The engineers also predicted that the double glazing idea will be used widely in the refrigeration field.

Ninth International Photography Congress

THE first International Congress of Photography was held in Paris in 1889. Since that time meetings have been held at intervals of three to five years, excluding the four-year war period, in Liège, Brussels, London, and Dresden, in addition to Paris.

The next congress, the ninth, will be held again in Paris next year, 1935, from July 7 to July 13. The meetings will be held in the rooms of the Société Française de Photographie et de Cinématographie, 51 rue de Clichy, Paris (IXe).

The Ninth Congress will be organized on lines similar to those of previous congresses. The active organization will be in the hands of a French committee consisting of representatives of many of the scientific, photographic, and allied societies of France, and headed by the French Photographic Society. The arrangements in other countries are made by the local National Committees. These committees have been established in many countries to deal with the proposals and recommendations of the congresses, to present material to the congresses for international consideration, to arrange for a series of first-class papers on appropriate photographic subjects to be submitted to the congresses, and so on.

The Secretary of the American Committee is Dr. Walter Clark, Research Laboratories, Eastman Kodak Company, Rochester, New York. There are two sub-committees in this country, dealing respectively with Sensitometric Standardization and Motion Picture Standards.

CURRENT BULLETIN BRIEFS

SCULPTURES BY HERBERT HASELTINE OF CHAMPION DOMESTIC ANIMALS OF GREAT BRITAIN, (Zoology Leaflet 13), provides an excellent representation not only of the particular champions which were used as models, but also of types illustrating physical characteristics of various outstanding breeds

of live stock. *Field Museum of Natural History, Chicago, Illinois.—25 cents.*

PUMPING FROM WELLS FOR IRRIGATION, Farmers' Bulletin No. 1404, gives much valuable information on types of wells and casings, pump equipment, casts, and so on. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE DESERTED VILLAGE (No. 4). Correspondence between Francis P. Garvan and Government officials regarding the development of the pulp-wood industry in the South. *Chemical Foundation, 654 Madison Ave., New York City, N. Y.—Gratis.*

101 USES FOR THE AIR-ACETYLENE FLAME. Every repair shop will welcome this handy reference guide which takes up a number of different fields in which the air-acetylene flame may be used, including plumbing and piping, air conditioning and refrigeration, marine work, automotive repair, power and electrical, and others. *Write for bulletin 10A to Scientific American, 24 West 40th Street, New York City. —Gratis.*

THE NEW PENN SYSTEM OF TEMPERATURE CONTROL. Prepared for distribution to members of the heating industry, this 28-page illustrated bulletin covers as briefly as possible the advantages and elementary features of a new concept in room temperature control. *Penn Electric Switch Co., 2000 East Walnut Street, Des Moines, Iowa. —Gratis.*

BIBLIOGRAPHY OF INFORMATION ON AIR CONDITIONING (No. 1383). This is the third edition of an interesting pamphlet devoted to trade associations, institutes, and societies interested in air-conditioning. The references to periodical literature are several hundred in number. *Bureau of Foreign and Domestic Commerce, United States Department of Commerce, Washington, D. C.—Gratis.*

MAINTENANCE OF RECIPROCATING PARTS. This pamphlet will fill a need for an adequate and authoritative treatment of the applications of the oxy-acetylene process. It makes a valuable addition to the existing literature on the subject of welding. *Write for bulletin 10B to Scientific American, 24 West 40th Street, New York City. —Gratis.*

TOWARD AN ELECTRIFIED AMERICA. An illustrated pamphlet showing the varied uses to which electricity will be put in the Tennessee Valley, the present aim being to electrify that valley; the ultimate aim is towards an electrified America. *Electric Home and Farm Authority, Inc., Chattanooga, Tennessee.—Gratis.*

WORLD WEATHER AND SOLAR ACTIVITY, by H. Helen Clayton. The latest of a series of Smithsonian Miscellaneous Collections bearing on long-range weather predictions. *Smithsonian Institution, Washington, D. C. —40 cents.*

THE NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Transactions, Volume XIII, 1932-1933). This volume goes into detail

on such subjects as "Motor Omnibuses a Century Ago," "The Evolution of Early American Bridges," and a dozen others. The Society was founded in 1920 and has an American branch with about 40 members. *A. Stowens, Hon. Treasurer, Science Museum, S. Kensington, London S. W. 7, England.—20 shillings.*

STRIKES, BUSINESS, AND MONEY

(*Continued from page* 179)

accord, would be slow and uncertain. The only sure and immediate way to full price-level restoration is an adequate adjustment of our gold *price*. This merely offsets the increased purchasing power of the commodity gold. *It is not inflation.* It is the surest way to avoid the printing press—which every sensible American knows can be more deadly than the machine gun.

How long will the capital goods industries stand by, losing profits for their stockholders, with billions of farmers' buying power destroyed—and much greater totals for other producers—because of blind adherence to an unchangeable quantity of gold?

Leaders of the national farm organizations see this. That is why they appealed recently to the Committee for the Nation to enlist support of the business world to induce the President to raise the price of gold at once to the limit authorized by Congress, and to work with agriculture for enactment by Congress of permanent monetary legislation to insure a dollar in the future more stable than the wildly fluctuating gold dollar which has nearly wrecked civilization.

I hear an outcry to this. "War, not money, wrecks civilization." But please remember that economic distress, due almost invariably to disastrous changes in the value of money, is usually the moving force behind revolution. Deflation is the handmaiden of dictators, be they Fascist or proletarian.

Marx and Engels, fathers of the Communist philosophy, knew this 85 years ago when Engels wrote to Marx that he hoped the flood of new gold from Australia and California would not end deflation, and Marx wrote Engels that he feared it meant postponing their dream of a Communist state for at least two generations.

Organized agriculture, with its strong political influence, invites industry to mobilize in support of immediate measures to restore our price level. This is the only way to cut the ground from under Communistic efforts to overthrow our social order.

Remember that the sparsely settled agricultural states have the preponderant vote in the U. S. Senate. Remember that the *kulaks* (independent farmers) resisted Russian communism long after city opposition had been suppressed. Remember that Theodore Roosevelt foresaw the wave of communistic influence and said the way to resist it in America was to make our farmers the bulwark of private property.

Can we awake industry to realize that it must act to save itself—to keep out European ideas, and preserve our American system?

Books SELECTED BY THE EDITORS

SIGNALS AND SPEECH IN ELECTRICAL COMMUNICATION

By John Mills

HIDING behind this somewhat "heavy" title is one of the finest pieces of writing on technical subjects for the layman that we have seen in many a day. In his preface, the author states definitely that he gives only what the general reader needs to know about communication, and no more. While no attempt has been made to write in words of one syllable—this is not a "boy's book"—the whole field of communication has been covered in a manner that will at once entertain the general reader and at the same time educate him in a sugar-coated manner. The text is arranged in a series of essays, following in logical sequence, and starting with a discussion of speech and its mechanics. Then all forms of electrical communication are treated to an extent that tells the whole story without becoming technical. The book is recommended for anyone who desires to acquire a background of knowledge of communication and its effects on our daily lives.—$2.15 postpaid.—*A. P. P.*

APPLIED GEOPHYSICS IN THE SEARCH FOR MINERALS

By A. S. Eve, F. R. S. C., and D. A. Keys, Ph. D., Professors of McGill University

SINCE it appeared in 1929, Eve and Keys' treatise has been the standard for those interested in scientific geophysical prospecting. It has now been brought up to date with a new edition. In 289 illustrated pages it treats of the magnetic, electrical, electro-magnetic, gravitational, seismic, radioactive, geothermal, and micro-paleontological methods.—$4.45 postpaid.—*A. G. I.*

SERVICING SUPERHETERODYNES

By John F. Rider

THE superheterodyne radio receiver of today is a complicated instrument and usually its explanation is attended by bewildering mathematics. This type of exposition has been carefully avoided in this book, which explains each one of the different parts of the circuit in a simple manner, clearly illustrated by schematic diagrams of commercial receivers. An entire chapter is devoted to harmonics, their generation, and the part they play in the superheterodyne. A large portion of the book explains what troubles may develop in this type of circuit and how they can be overcome. An appendix contains the intermediate peak frequencies of hundreds of commercial receivers. The author has happily combined theory and practice. The latest developments of the superheterodyne, such as automatic volume control, visual tuning, wave-band changing systems, and so on, are explained in a way that can be comprehended readily by beginners and advanced students of radio.—$1.15 postpaid.—*A. P. P.*

THE WORLD IN MODERN SCIENCE

By Leopold Infield, Lemberg University

THIS 274-page volume, a translation from the Polish, contains an introduction by Professor Einstein who says: "The intelligent layman can obtain from this book a profound insight into the problems of modern physics, and anyone who is anxious to acquire knowledge will find the theme of this book no less dramatic and absorbing than an exciting novel." Doubtless Professor Einstein finds such a volume light, dramatic reading but when looked at from a more nearly average man's angle it is a non-mathematical exposition of atomic physics which will require perhaps more careful, thoughtful reading than it will give dramatic excitement. It will, however, impart a very good knowledge of modern atomic physics. A book neither for low-brows nor high-brows—about medium in hardness.—$2.20 postpaid. —*A. G. I.*

EARTH, RADIO AND THE STARS

By Harlan True Stetson, Ph.D.

NO book like this—covering the same scope and the same corners of science—has been written before. The author, a noted astronomer, is now Research Associate in Geophysics at Harvard University, and has made a long study and done much research on the connection between sun spots and radio reception, with numerous cognate problems in physics and geophysics. Some of the chapter subjects best describe its contents: The effects of the moon on the earth; ocean and earth tides; variation in latitude and longitude caused by the moon; the earth's interior; sun spots and their effects on life, earth's magnetism, radio reception; effects of the moon, the stars, solar eclipses, and meteors on radio, and the significance of these effects; cosmic clouds, cosmic rays, and cosmecology. This book concerns the geologist, the physicist, the meteorologist, radio engineer, and astronomer and is one of the broadest, most important, most informative books of the year—a great synthesis. It is written understandably.—$3.15 postpaid.—*A. G. I.*

THE DINOSAURS

By W. E. Swinton, Ph.D.

THIS is a short (209 page) history of the age of dinosaurs, written by a dinosaur specialist of the British Museum of Natural History. An attempt was made to aim it at both the paleontologist and the public, and with unfortunate results, for it is of very unequal difficulty. Those who know their paleontology will find it satisfactory, while others will derive at least some value from it. The many kinds of dinosaurs are described. There are 25 illustrations.—$4.75 postpaid.—*A. G. I.*

THE ELEMENTS OF ASTRONOMY

By E. A. Fath, Prof. Astronomy, Carleton College

ONCE more Fath's notable text-book of astronomy has been revised, largely rewritten, brought up to the end of 1933. Some 52 pages and eight star charts have been added. This is a non-mathematical text-book suitable for the beginning student or reader, and it covers the science of astronomy as taught to students in elementary college and high school courses (in both of which, by the way, it is widely used). Its outstanding characteristic is the fact that its author anticipates the special stumbling blocks that generally stand in the way of the reader's attempt to grasp explanations of the more difficult parts, and in a pat sentence or two removes them. This new edition, the third, has 345 pages and 238 illustrations.—$3.20 postpaid.—*A. G. I.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Chicken Capsules in Patent Suit

TO administer medicinal capsules or pills having insoluble coatings to human beings would be about as efficacious as feeding them so many pebbles or stones. However, a capsule or pill containing a vermifuge and having an insoluble coating is a most effective instrument for treating fowl for worms in the intestines and so the Circuit Court of Appeals for the Third Circuit held in the recent case of Geo. H. Lee Company v. Pratt Food Company.

The suit was brought by Geo. H. Lee Company, on Patent No. 1,778,264, and charged that the Pratt Food Company, by manufacturing and selling a capsule or tablet with an insoluble coating for treating chickens and other fowl suffering from intestinal worms, had infringed the patent. The Court found that prior to the invention of the capsule disclosed in the patent in suit various attempts had been made to treat fowls for worms in the intestines, all of which were more or less unsuccessful. The worm medicine had been mixed in troughs with chicken food but the healthy chickens which had no worms consumed the major portion of the food and got most of the worm medicine, while the unhealthy chickens which had worms got little or no food or medicine. Furthermore, it was found that the medicine was diluted or absorbed in the alimentary canal before it reached the intestines where the worms are lodged. Another attempt had been made to administer the vermifuge by means of a catheter, but after trial that method was found ineffective for various reasons.

The patentee overcame the prior difficulties by the simple expedient of incorporating the vermifuge in a tablet or capsule having a coating unaffected by body heat and insoluble in body fluids but frangible so that it could be broken by mechanical action in the gizzard. The gizzard is located immediately in advance of the intestines and the medicament is therefore disgorged full strength into the intestines where it effectively eliminates the worms.

After considering the evidence, the Circuit Court of Appeals stated:

"The proofs show that a capsule of such functional capacity was new in the art. It was useful, as is shown by its rapid, extensive and growing use."

The Court found the patent valid and infringed and awarded an injunction and accounting to the Geo. H. Lee Company.

Position of Trade Mark

IN *ex parte* Eastman Kodak Company, First Assistant Commissioner Spencer held that the company, of Rochester, New York, is not entitled to register, under the Act of 1905, the notation "Twindar" as a trade mark for photographic lenses because there is not shown to have been any trade mark use of that notation on the goods specified.

In his decision, after stating that a part of an article can be trade marked if it is separately marked and that it appears that a trade mark for the lens could be readily placed upon the lens mount, the First Assistant Commissioner said:

"The appearance upon the body of the Kodak of the words 'Twindar Lens' does not amount to trade mark use of the notation; on the contrary, the words are employed purely in their descriptive or explanatory sense to indicate to a prospective purchaser the fact that the Kodak is equipped with a lens of that particular name or trade mark. When employed in this explanatory fashion, it fails to indicate the origin of manufacture and therefore fails to carry a trade-mark significance."

False Statements About Aluminum

STATEMENTS to the effect that the use of aluminum cooking utensils causes cancer or other grave maladies or of the increase of such disorders among the users of such utensils, will be discontinued by an individual engaged in the sale and distribution of cooking ware, as a result of a stipulation of the Federal Trade Commission. Several other representations will be abandoned by this individual, including one to the effect that thousands of people are dying every day from cancer because of their use of aluminum cooking utensils and one to the effect that doctors and hospitals are now advising people against the use of aluminum utensils because of poisonous effects.

Correspondence School Misrepresentations

HOLDING out of false prospects to prospective students is charged in a formal complaint issued by the Federal Trade Commission against Lincoln Extension University, Inc., of Cleveland, Ohio.

Misrepresentation of earnings possible to be attained by pupils who take the course is charged in the complaint. The respondent advertised that knowledge and power to be derived from this course "should certainly add at least an average of 100 dollars a month to your earnings for the rest of your working life." It was said also that "in only twenty years this will amount to 24,000 dollars, which you would not have earned without the training service."

The respondent is charged with misrepresenting to prospective pupils that their names had been submitted by the management of a factory or other place of employment, thus causing the pupil to believe that if he were to purchase the required books and take the course, his prospects for employment or promotion would be bettered.

"An ordinary common school education is absolutely all one needs to tackle this training service," the school asserted in advertising to prospective students, "but at the end of it (the training service), a Lincoln man can rub shoulders with college graduates and be accepted as one of them."

The respondent, according to the complaint, is not the equivalent of a university nor do the books and pamphlets comprise an extension of any university.

Untruthful Patent Statements Curbed

THE Chaney Manufacturing Company, Springfield, Ohio, manufacturing barometers and thermometers, agrees, as a result of action taken by the Federal Trade Commission, to cease stating directly or indirectly in advertising matter or otherwise that it owns United States or other patents on a combination containing a thermometer and barometer or on either the thermometer or barometer. The company also agrees to cease using the words "we own all patents on same" and "patented by" or words of equivalent meaning in a manner to deceive purchasers into believing the corporation has exclusive right to make, use and sell these products or that it owns active patents on them when this is not true.

Monopoly Charge is Not a Patent Suit Defense

IN Federal Court recently Judge Philip Forman struck from an answer to patent infringement suits charges that the Radio Corporation of America and the General Electric Company had an "illegal monopoly" of radio patents.

The Hygrade Sylvania Company, of Massachusetts, as a defense to suits by the two companies charging that it infringed radio tube patents, had replied that the companies violated anti-trust laws.

The court said it was a "well settled question" that in a patent suit charges that the plaintiff is party to an unlawful combination do not constitute a defense.

The Hygrade company had charged that it made every effort to obtain licensing agreements on reasonable terms but had been refused solely because of the "illegal agreement" to restrict licenses.

"The fact is," the court said, "that the government approved the agreement as lawful and consented to its execution. . . . The patents are the Radio Corporation of America's and the General Electric's property, and that being the fact, they may refuse to license or license as they choose. The owner of a patent has a limited monopoly. Whether the refusal to license is based on a commendable or odious reason is immaterial. The law allows the inventor absolute property in his invention."

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NINETIETH YEAR • ORSON D. MUNN, Editor

CONTENTS · NOVEMBER · 1934

The SCIENTIFIC AMERICAN DIGEST

Cover

STEEL is the backbone of many industries of the world; stainless steel in particular has opened many new fields of endeavor. Important in its manufacture is nickel, the story of which is told in the article starting on page 229.

SCIENTIFIC AMERICAN, November, 1934. Vol. No. 151, No. 5, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Copyrighted 1934 by Munn & Company, Inc. Great Britain rights reserved. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

We Look to the Future

WHEN the young inventor, Thomas A. Edison, gave the first demonstration of his phonograph in our old offices in lower Broadway, SCIENTIFIC AMERICAN had been "selling" scientific and industrial progress to laymen for decades. During those early days, from 1845 onward, the ingenuity, the inventiveness, the vision of progress, and the individual initiative of Americans were in their early ascendency. Like an onrushing flood, the "American idea" swept on and on, slowly gathering momentum until, during the past few years, its growth has been so phenomenal as to set it apart as a model for the world to emulate.

Yet, just three months ago we said editorially: "Progress has only just begun," and the month before that: ". . . by use of a little imagination, new depths of demand can be reached and new demands created; by use of a little extra energy and courage, products can be sold; and by employing research as never before, progress can be made. Our next and infinitely greatest frontier is the frontier of science and invention, and this frontier extends to the stars!"

Vision, courage, progress—a frontier that extends to the stars! SCIENTIFIC AMERICAN has always appraised this frontier; has interpreted and evaluated (in understandable fashion for the far-sighted, thinking layman) the myriad applications of science that lead toward the better life; has given an authoritative picture of the present that, in turn, gives a vision of the future. Our pages have exhibited, for those with analytical eyes to see, an architect's perspective of the complete tower of science-made civilization pointing to the stars, the stones of which are the advances of science in human affairs.

The tempo now changes. Doubts and uncertainties are in the minds of men, planted there by theorists and dreamers. Isms abound, grow more insidious, and would undermine the foundations of man's tower of achievement. The old order, say the cultists, is all wrong; we must stop making machinery, curtail production, organize for collective control, pay higher wages—in fact, industry suffers on all sides. In spite of its vicissitudes, however, industry takes the long view and marches valiantly ahead, slowly it is true, but none-the-less surely.

Our cue is here. Long the champion of typically American progress and mentor to the layman, SCIENTIFIC AMERICAN adopts a more vigorous editorial policy. If the laissez faire world has gone into the discard, much palaver in abstractions by "economists" are but straws in the wind; they cannot erase the bewilderment from your mind. Hard facts, however, are weather vanes; they not only show the way the wind is blowing, but, their proper significance being adduced, they will also foretell the future hurricane of developments. SCIENTIFIC AMERICAN has always presented such facts for the wise ones to use and numerous letters attest the great profits made thereby. Now, we present them more vigorously, will emphasize them as never before.

SCIENTIFIC AMERICAN will continue to champion the cause of progress for we do not think the principle of individual enterprise is out-moded, will champion it more courageously, fearlessly, with facts that cannot be refuted and which will serve to guide us forward to the better life, to give a vision —a vitally important vision—of the future!

Editor and Publisher

Personalities in Science

FRAULEIN EDITH KROUPA

WITH Nazi bombs exploding and rifles cracking in the most recent Vienna revolution, Fraulein Edith Kroupa, a research chemist at the University of Vienna, sat calmly in the laboratory of Professor A. Franke, conducting a trying micro-chemical analysis of a tiny rock sample sent from near Winnipeg, Canada, to determine the age of the earth. The two activities, revolution and research, are doubtless somewhat incongruous when pursued at the same time in the same city, and one may possibly conclude that the conduct of ultra-precise chemical analysis in the midst of a small war must demand the qualities of a heroine. But the chances are that Fraulein Kroupa, as she worked, was scarcely made aware of the event of lesser importance, that is, the local war, since Vienna is a large city and its average resident is doubtless made little more aware of its average revolution, than the average citizen of an American metropolis is made immediately aware of the bank robberies and gang wars which are somewhat too average in our own "peaceful" land. And so Miss Kroupa determined the age of the earth and found it to be at least 1,725,000,000 years.

What the feminine scientist, who happily does not find it inconsonant with the aims of good science to wear a pretty hat, did in the bit of research in which she participated was to employ special methods of making what chemists call a micro-analysis. These are newer, more refined methods than some others. The aim is to ascertain the ratio of the radioactive material of a rock sample to its radioactivity product, lead. The sample she analyzed microchemically weighed only one hundredth of an ounce, but such a sample is enough for this work.

It will be recalled that the radioactivity method of determining the earth's age has supplanted earlier methods, such as determining the ratio of salt in the ocean to that in the land rocks. This method has given to geologic time a sufficient length to satisfy the biologists, who previously asserted that 100,000,000 years or so was not enough to allow for the whole course of evolution of life on earth. Science now gives the earth an age of at least two billion years.

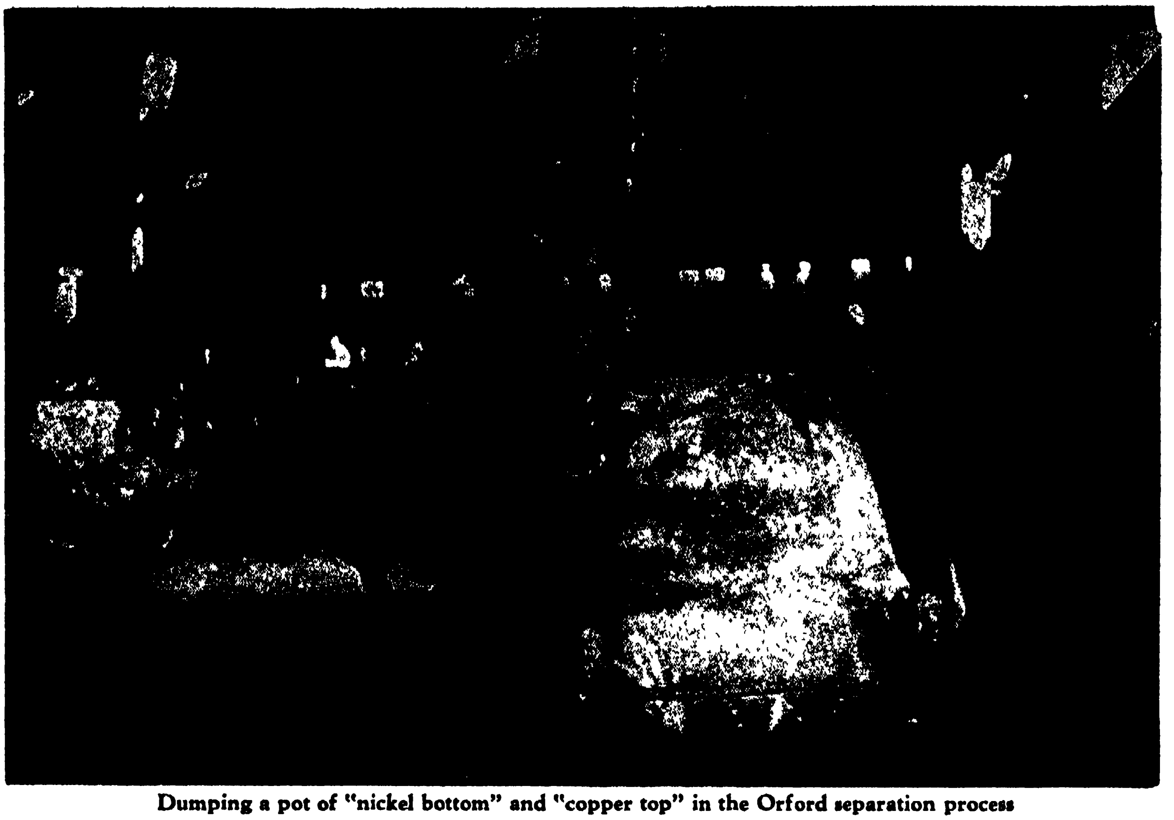
THIS is one way the radioactivity method is figured out: In ancient rocks, and younger rocks as well, geologists long ago found tiny haloes, visible only under strong microscopes because they were so small, which seemed so uniform in diameter and so geometrically perfect that their representing any kind of fossil seemed improbable. Years later it was found that these haloes were merely the exposed cross-sections of spheres, each sphere surrounding a minute particle of a radioactive element, thorium or uranium. These spheres represent the product of the slow breakdown of the central radioactive particle into lead, and the ratio of the radioactive element to the lead present gives a measure of the age of the rock in which the spheres or haloes occur. In rocks known by other kinds of evidence to be younger there is found to be correspondingly less lead. This method has become standard in ascertaining the age of the rocks.

Only by a most delicate micro-analysis can the uranium-lead ratio be determined accurately, and that sort of analysis is what Fraulein Kroupa has become expert in making. It is work that requires painstaking care and precision, for the quantities of each component involved are almost microscopic.

ience Service photo

A RICH NEW DISCOVERY OF DINOSAUR REMAINS

IN Wyoming, Dr. Barnum Brown, paleontologist, on the staff of the American Museum of Natural History, New York, has discovered a fossil dinosaur-wallow 125,000,000 years old, and in it the skeletons of 12 or more large dinosaurs. The significance of this find is not that dinosaurs, as such, have been found, for these have not been especially rare, but mainly the number found in one place, their fine condition, and the fact that parts of the same species found incomplete elsewhere are supplied by this discovery. Another lucky strike was the unique discovery of a piece of petrified dinosaur hide.



Dumping a pot of "nickel bottom" and "copper top" in the Orford separation process

'NEAR NOBLE' NICKEL

By JOHN F. THOMPSON
Vice President, The International Nickel Company of Canada, Limited

Of Great Industrial Importance . . . Used Daily by Millions . . . Chromium Promotes Nickel Plating . . . 49 Percent Used in United States . . . Vital in Automotive Design

IN the eternal quest of science for better materials with which to meet the demands of modern industry, nickel has found in recent years fertile soil for spreading the roots of a great industry of its own. Its versatility in joining with other metals to effect better properties and performance gives it a near nobility in the modern alchemy of alloys.

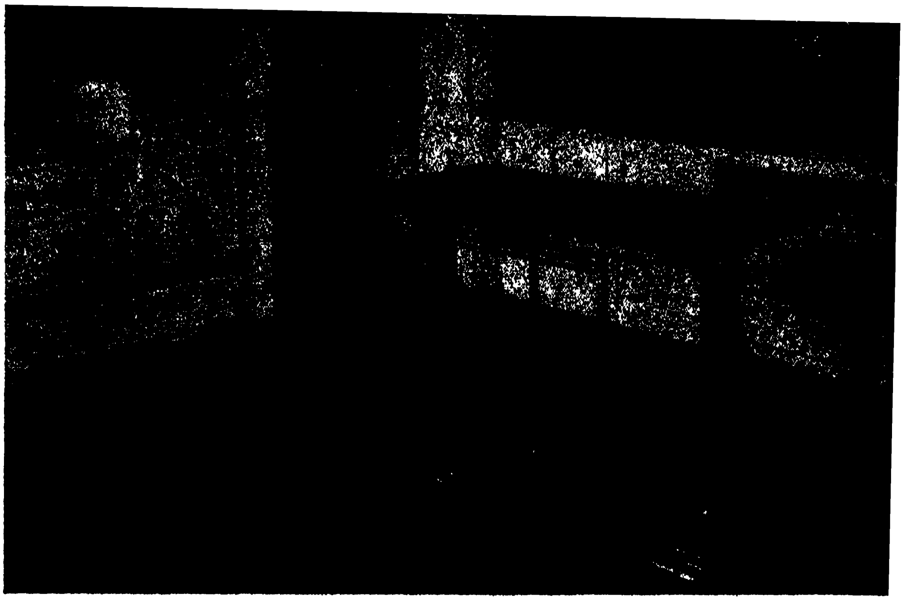
To the average layman, nickel is usually associated with plating; yet the metal is part of his latch-key, of his bathroom fixtures, of his table silver, toaster and percolator, of his radio and of many another product that he uses daily. The association of nickel with plating carries the further thought that chromium plating has largely driven out nickel; the truth is that chromium plating is very generally done over a comparatively heavy underlay of nickel plate, thus contributing to the further use of nickel in plating. Another phase of popular confusion about nickel is that it has supplied the nickname for the American five-cent piece which is only 25 percent nickel and the balance copper, although some 27 other nations, including those as close as Canada and as distant as Abyssinia and Japan, are using coins that really are pure nickel.

DURING the last five years the United States has consumed nearly as much nickel as the rest of the world put together, its share of world deliveries for that period having been 49 percent. In five years American consumption exceeded 100,000 short tons, or an average of more than 40,000,000 pounds a year. As a result, this country is making some of the most spectacular uses of this white metal.

For example, the Empire State Building and the Chrysler Tower are sheathed with stainless steel, the chromium-nickel alloy containing 8 percent nickel; and the same material has been used by the E. G. Budd Manufacturing Company to construct all but the trucks and engine-bed of the "Zephyr," the Burlington Railroad's entry in the new competition between trains and airplanes.

Nickle-copper block (see above) is broken by mechanical fracture

Monel Metal, the natural alloy reduced directly from ores in which the nickel-copper content maintains the ratio of two parts of nickel to one of copper, is used for the propeller shaft of Gar Wood's record-holding speedboat, for turbine blading on the *Bremen*, *Rex*, *Manhattan* and other ocean greyhounds, and for the pontoons of some of the latest seaplanes. It provides the working surfaces for soda fountains, hotel and restaurant kitchens, packing and canning factories as well as for operating rooms in hospitals. At Boulder Dam it not only forms the important valve seats which will control the flow of water, but it is also being imbedded as grout stops (expansion joints) in the massive masonry of the dam itself. According to the present schedule, more than 250,000 pounds of this alloy will go into the dam. Used as the roof for the Pennsylvania Station in New York City, Monel Metal has already had 26 years of exposure to the elements, and a recent test indicates that this roof will last for 100 years more.



Monel Metal, corrosion resistant, used for working surfaces in a modern kitchen

ALLOY steels of low nickel content have become the feature of modern automotive design where increased strength and safety are required with no increase in the sections and weight of the main structural parts. And some 3500 tons of these nickel steels are going into the construction of the San Francisco-Oakland Bay Bridge.

At the same time the production and the applications of cast iron, one of the oldest industrial materials, are being revolutionized by the results obtained from including nickel either alone or in combination with other alloying elements. These new cast-iron alloys not only show smaller losses from imperfections and breakage in casting and machining, but they also offer properties and performance through which cast iron is regaining an important place in the modern industrial world. Their greater toughness and wear-resistance are finding uses for them as brake drums for busses and trucks, as manhole covers which must withstand the heavy impacts of modern street traffic, and as parts for rock crushers, dredges, and other machinery subjected to abrasion.

Crane transferring ladle from converter in nickel separation process

In the electrical field nickel demonstrates its greatest versatility. Certain nickel alloys are magnetic; others are non-magnetic. The volume of messages which a transatlantic cable can handle has been multiplied 15 times by the use of Permalloy, an alloy developed by the Bell Telephone Laboratories and containing 78 percent nickel and the balance iron. The telephone companies employ the same nickel alloy to make long-distance conversations clear, and another type in the "boosters" to increase the volume of sound transmitted. The whole development of electric irons, toasters, percolators, and ranges for household use depends largely on a special nickel-chromium alloy for the heating element. Every metal part in the interior of a modern radio tube is either pure nickel or an alloy predominantly nickel.

PERHAPS the most recent finding of science has to do with the development in New York of a nickel-chromium-iron alloy under rigidly controlled heat and quenching conditions to produce a foolproof material for spring scales. As far back as 1678 Robert Hooke, eccentric English experimenter, proclaimed what physicists have since known as Hooke's Law. It is that "the power of any spring is in the same proportion with the tension thereof: That is, if one power stretch or bend it one space, two will bend it two, and three will bend it three,

and so forward." In the many years which have ensued, that law has been observed more in the breach than in the performance, because deviations appeared as the theory was applied in actual practice. A series of "errors" came to be recognized in the spring scale industry — the temperature error, the straight line error, and errors due to creep and hysteresis. Various methods were developed as compensations, but the inherent errors persisted. Spring scales therefore had to be made and assembled by highly skilled manual labor.

DOWN in the shadow of Brooklyn Bridge there is an Old World pocket which has resisted the encroachment of skyscrapers. Known to native New Yorkers as "The Swamp," it is the place where John Chatillon and Sons have been making spring scales for nearly a century. Five years ago Robert B. Wasson, research engineer of the company, began experimenting. Dr. A. V. de Forest and Prof. Mortimer Sayre served as consultants. Now he has perfected the Iso-Elastic Alloy which eliminates the errors due to temperature changes, creep, or hysteresis in helical, or spiral, spring scales; and he has worked out a geometrical form for the spring wire, which automatically corrects the straight line or torsion error.

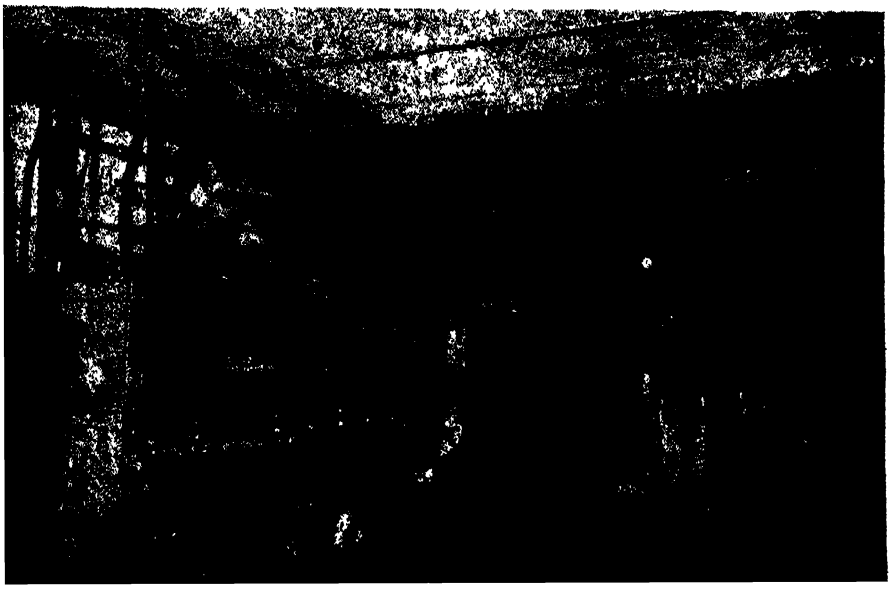
Iso-Elastic Alloy is essentially a modification of Invar, a nickel iron alloy developed years ago by the French metallurgist, Guillaume. Not only does it make possible spring scales on which both butchers and grocers and their customers can place reliance; it also has potential uses wherever a spring operating under wide temperature changes is the activating principle of an instrument. For example, truck manufacturers are already investigating the use of this alloy in the manufacture of governors to set the maximum speed at which trucks can be driven. Heretofore the accuracy of such instruments has been affected by the temperature variations under the engine hood.

Converters where copper content of nickel ore is blown to "blister"

Thus research initiated by various industries—and notably by those in the electrical field—supplements the research and development work of the nickel industry itself in finding new uses for nickel and in broadening its older applications.

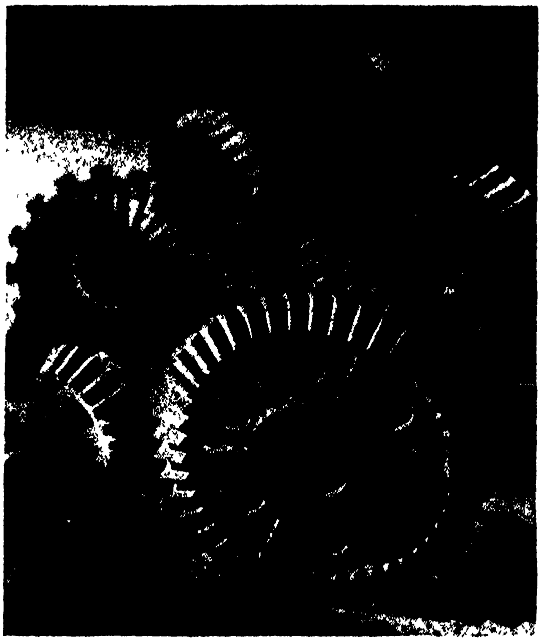
From the standpoint of weight percentage, nickel occupies sixth place among the 92 components of the earth's crust; yet there are only a handful of known concentrations sufficiently important to justify mining on a commercial basis. Of these the Sudbury Basin, a small area in Ontario, supplies 83.5 percent of the world's consumption; the next most important field is New Caledonia with 10.5 percent. Germany, Norway, Greece, Japan, and Burma together furnish the remaining 6 percent of the world's requirements. The New Caledonian fields were the most outstanding source of the world's nickel supply prior to the development of the Canadian deposits.

At the 2800-foot level in the Frood mine: A rotary dump handles six-ton cars



THE dominant factor in this situation is the Frood Mine which is located a few miles from Sudbury. So far, explored to a depth of 3300 feet, it already shows a reserve of some 135,000,000 tons of workable ore; neighboring mines bring the aggregate of proved ore above 200 millions.

These deposits take the form of pyrrhotite-chalcopyrite ores containing copper and nickel in comparatively large quantities, and gold, silver, the platinum metals, and selenium and tellurium in sufficient quantities to make



Industry is geared to nickel steels

their recovery a factor in the economical production of the nickel. Discovered in 1883 when the Canadian Pacific Railway was being pushed westward through Ontario, these ores duplicated the difficulties and exasperation experienced by the Saxon miners of the early 18th Century, who wrestled in vain with similar ore and finally dubbed it *kupfer nickel* on the theory that "Old Nick" and his gnomes had bewitched perfectly good copper ore.

The primary metallurgical problem is one of separating the nickel from the copper on a commercially practical basis. Two successful answers have emerged as standard. One is the Orford separation which depends on the chemical action of sodium sulphate on copper-nickel sulphide in the presence of carbon, the sodium sulphate turning to sulphide and joining with the copper sulphide in a solution which is lighter than the molten nickel sulphide that has been but slightly affected by the presence of the "soda." Thus, when the charge is tapped from the blast furnace into great pots and allowed to cool, the nickel sulphide settles in the bottom and the copper-soda solution floats on top. After the contents have solidified, the pots are dumped, and there is an easy fracture of the two masses. This method of separation is the one used in the Canadian process, and it also has become a basis for the other type of separation.

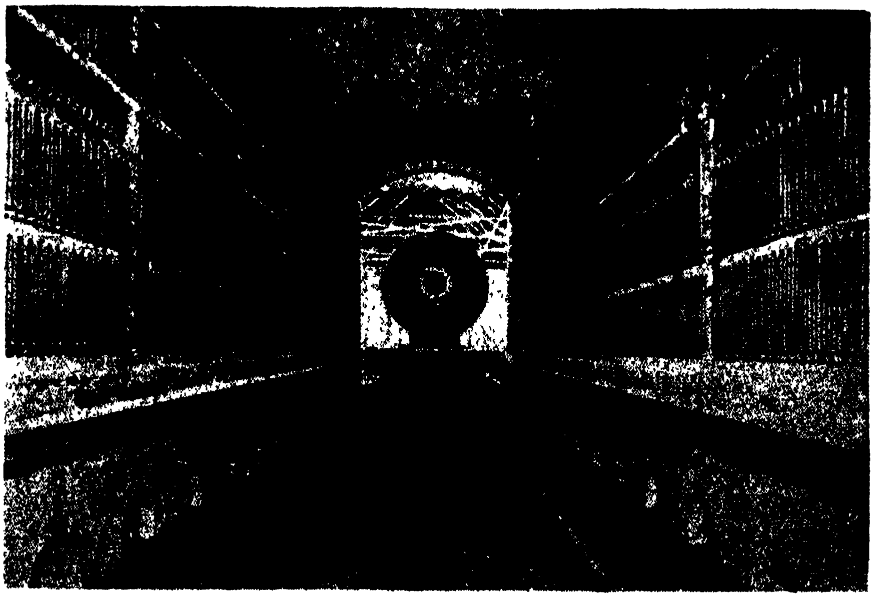
THE other answer to the metallurgical problem is the Carbonyl separation in which finely divided metallic nickel is volatilized with carbon monoxide at one temperature and is deposited out of the gas at a higher degree. Developed by the Mond Nickel Company in the United Kingdom, the process employed has been modified since the amalgamation of that company into The International Nickel Company of Canada, Limited. Originally copper-nickel matte from Canada was the basis of the Mond process, as much as possible of the copper being leached out as a preliminary to volatilization. At the present time, some nickel matte produced by the Orford process is used, thus anticipating much of the copper elimination. At the same time the process developed in Canada around the Orford separation has been improved by the use of selective flotation in the concentrator to effect a rough separation of the copper and nickel contents of the ore prior to the blast-furnace operation with sodium sulphide.

To produce the pure nickel of commerce the Canadian method is to reduce the Orford matte by final elimination of the sulfur and then to cast nickel anodes some 96 percent pure. Placed in electrolytic tanks, these anodes are turned into cathode nickel more than 99 percent pure. The sludge from the tanks is treated for the removal of the gold, silver, selenium, and tellurium; the residue after these treatments is shipped as a concentrate to the company's precious metals refinery at Acton (a suburb of London, England) where the six platinum metals are recovered and separated.

AS for copper, the most important by-product of these nickel operations, most of it is separated out either in the flotation tanks or in the "copper tops" of the Orford separation; and the blister copper thus produced is refined in the electrolytic plant of Ontario Refining Company a few miles from where the ore was mined. Such copper as finds its way to the Mond refinery at Clydach, Wales, in the "nickel bottoms" of the Orford separation, is leached out as copper sulphate. The copper content of the ore—the copper by-product!—is such that International Nickel ranks as the sixth largest of the world's copper producers.

SUPPLEMENTING these various operations is the production of Monel Metal as a natural nickel-copper alloy by direct reduction of ore from the Creighton mine. Situated within a few miles of Frood, this mine produces an ore in which the precious metal content is low and the nickel-copper ratio runs two parts to one. The properties of an alloy containing two-thirds nickel and one-third copper are such that Monel Metal has established itself as standard for many industrial and household uses where both strength and corrosion resistance are required. The reduction of the matte and the production of sheet, rods, bars, tubes, and the other forms in which Monel Metal is used, are carried out in a mill at Huntington, West Virginia, nearly 90 percent of the world's consumption of this alloy being in the United States.

Thus science has come a long way since the early Saxon miners discarded copper-nickel ore as being bewitched. An important field of metallurgy has been developed in learning how to separate these two important metals and how to use them in their natural combination. It is an alchemy based on the recognition that simple metals must make way for the alloys in meeting the demands of modern life.



In the largest electric furnace of its type in the world—73½ feet long, 25 feet high, and 19 feet wide—special nickel alloy heating elements line the walls

OUR POINT OF VIEW

"Glorious Failures"

PERHAPS the critics of the American attitude are right. Perhaps Americans *have been* entirely too optimistic and yet the most unhappy people in the world. Perhaps, as cynical foreigners frequently state, Americans do carry to extremes exaltation of bigness: "the greatest this" or "the greatest that" in the world. Perhaps, moreover, American science does scold the people for improperly utilizing the products and by-products of science, without itself offering a helpful suggestion as to how that may best be done; or too quickly we shrug our impatience at Secretary of Agriculture Wallace's strictures in the June SCIENTIFIC AMERICAN.

Suppose we plead "guilty" to all of this? We are optimistic and we are unhappy. We do glorify bigness, and yet for the most part this is for purposes of symbolizing achievement, and inspiring to further developments. The scolding is merited—we are yet a young people. Well, what then? Shall we adopt lugubrious masks to cover our faces, and sit hopefully awaiting a miracle that will carry us forward through the maze of scientific achievements, without a single mistake? Certainly there shall be no scientific holiday. Shall we turn to the critics for help? So far they've given no constructive criticism but doubtless they *have* a plan or two. Let them advance it; we are open to suggestions—in the scientific method!

Errors we have made in the past. We admit it and as candidly confess that we expect to make more. Only he who stagnates in the placid pool of certainty makes no mistakes—and no progress! Those who dare to forge valiantly ahead, gambling, if you will, with uncertainties, make both!

* * *

By an odd coincidence, just as this issue goes to press, Sir James Jeans, speaking in Scotland at the annual meeting of the British Association for the Advancement of Science, said, while discussing the value of science and invention and the question of technological unemployment:

"Is it not better to press on in our efforts to secure more wealth and leisure and dignity of life for our own and future generations, even though we risk a glorious failure, rather than accept inglorious failure by perpetuating our present conditions, in which these advantages are the exception rather than the rule?

"Shall we not risk the fate of that overambitious scientist, Icarus, rather than resign ourselves without an effort to the fate which has befallen the bees and ants? Such are the questions I would put to those who maintain that science is harmful to the race."

Television—How?

SCANNING disk or cathode-ray tube? This seems to be the burning question in television experimental work today. The scanning disk is being marvelously improved; the cathode-ray tube is proving to have many "bugs" difficult to overcome. Still the public has not been offered a real opportunity to "play around" with television. When will they have this chance, and what form will the equipment take? We await the answer of the televisionists with interest.

100,000 Scientists on Strike. Treason?

TO the human beings who are living in our present era its most important events must often seem to be its great wars and political occurrences, but future historians doubtless will discern that by far the most important events of our times were its scientific discoveries. Neither Alexander nor Caesar nor Napoleon has exerted a fraction of the effect on human history which has been exerted by the scientists Galileo, Newton or Darwin, since their discoveries and similar ones underlie our whole Age of Science. Almost any single invention or discovery - for example, the harvester or the germ nature of disease—puts vastly more wealth into the world than the whole World War took out of it. The most important thing for the human race to keep in sight in our age is, then, that through thick and thin, scientific research must march steadily on. Taking the long view of things, this is the *main bet.*

Now that the world is becoming more and more jittery about the risk of new wars, scientists are trying to think up a formula which will provide that in the event of another such occurrence this "main bet" in human affairs, this invaluable thing called scientific research, shall not be interfered with by so relatively unimportant a sideshow as our last world war, but will proceed unruffled.

At a meeting held in Brussels the International Council of Scientific Unions, premier overhead organization of all scientific organizations of the world, has just been seeking a way to maintain "by all means international co-operation in the domain of science under whatever circumstances may present themselves." This statement may be taken to mean that scientists are serving plain notice to the rest of the people of the world that if the world is ever again so idiotic as to become involved in another disastrous dog fight like the last one, concerning things that are of relatively little importance, these scientists will refuse to stop the much more important things which they are doing, and likewise will refuse to lend their aid to the several participant nations under which they live.

The 100,000 scientists of the world are its best minds In their thoughts and attitudes they are far in advance of the rest of the population. Among themselves these men, regardless of the accident of nationality, form a brotherhood which is essentially international; more accurately, non-national. Science ignores political boundaries. In the spirit of their commingling and co-operation scientists thus furnish the closest existing approach to practicing internationalism which the world can show today.

But scientists could even do more than to refuse to stop co-operating across national boundaries in time of war or actually engaging in these childish squabbles themselves. They could even refuse to help the politicians and soldiers when war comes. They could go on strike. Without the aid of the scientists and their discoveries (which were never meant for use in war) those who make wars would then be left sadly in the lurch, for war today depends in nearly every aspect on modern science, and the scientists, without at all desiring to be, are its key men. This would reduce war to a far more limited scope than it now has, both in terms of men and of money. As a result of this there might remain in the world enough money for the steady promotion of scientific research—the main bet we have spoken of.

In thus sticking to the logic of cold reason, and steadfastly ignoring human passions, local and temporary, scientists would be placing "patriotism" toward the whole human race, present and future, even above the loftiest existing ideals of patriotism.

And how the scientists could squeeze the politicians and soldiers, merely by sitting down and refusing to be their tools and play their destructive game!

Scientific Methods of Game Breeding Will Make

GOOD HUNTING

By GEORGE S. McCARTY

Former member, New Jersey State Fish and Game Commission

Game Raised Artificially . . . Low Cost . . . Game Fed in Natural Haunts . . . Gunner-Farmer Co-operation

ONE of the natural heritages of citizens of the United States is the right to pursue the ancient and honorable sport of the chase, hunting wild game as a recreation and as an outlet for primitive instincts which, perhaps, have been more carefully nurtured here than in other lands. Our forefathers lived by their skill as hunters and fishermen, and it is no wonder that we of the present day have a distinct leaning toward the same pursuits, but for sport rather than from necessity.

But the United States of today is a far different hunting ground than was the case 100 or even 50 or 25 years ago. Rapid increases in population, particularly around centers of business and industry, have steadily wiped out large areas which formerly were favorable to natural breeding of game birds and rabbits. The motor car has done its part by making remote areas easy to reach. The state of New Jersey is an excellent case in point. Dotted with numerous industrial towns, heavily populated, and adjacent to New York City and Philadelphia, the situation for the gunner and fisherman has become acute. Large areas of brush and woodland have been cleared for agriculture, and much of those lands which are available for gunning has been posted against trespassing.

A pair of breeding bob-white quail

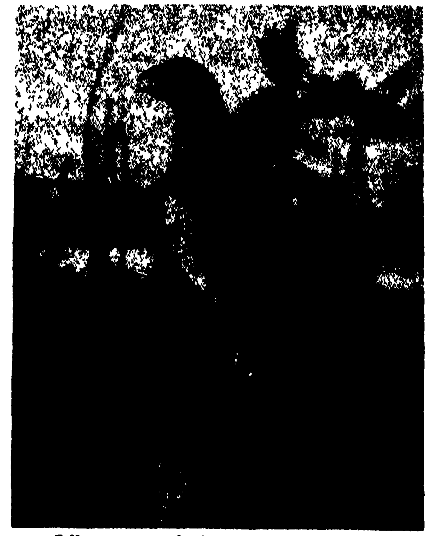
What can be done to make good hunting available for the man of average means, under such conditions? The method of expensive game preserves limits shooting to the few, while we in the United States want and can have it for the many. For eight years I have studied the problem and on my farm near Newfields, New Jersey, have reduced to practice a system of game breeding and allied projects that, if properly handled, will provide self-perpetuating sport in densely populated areas.

The author feeding young grouse

While my work has been done in New Jersey, with conditions in that state particularly in mind, the system is applicable in any state in the Union where intensive gunning and improper efforts at restocking have resulted in a dearth of game.

This system may be broadly divided into four parts as follows:

1. Co-operation must be secured between the land owner and the gunner, so that hitherto posted areas will be opened for hunting.
2. Game must be raised artificially at a much lower cost than at present.



Ol' man ruffed grouse broadcasts

3. Food for game must be planted at strategic points.
4. Predators, both winged and four-footed, must be controlled.

It will be noted that these four points are dependent largely upon each other, and that failure of one will rapidly undo any good that might arise from the others.

While point number 1 is perhaps the most vital of the four, it hinges so strongly on number 2 that the latter will be discussed first. I have demonstrated that, with proper care, it is entirely possible for anyone to raise game in a small area. I would set up, under the supervision of the state game commission, or similar body, a plan whereby the farmer or his sons and daughters would be instructed in the raising of game and supplied with the necessary equipment, or told how to build it. Then the game could be purchased by the state when sufficiently grown, and either released at once or held over the winter in state lands.

BIRDS and rabbits so raised can be purchased at a much lower figure than is possible today, and every farmer on whose land the raising is being done will be a fast friend of the gunner. I fully believe that 200,000 dollars a year can be put in the pockets of the

A bantam hen watches over her brood of quail

farmers of New Jersey under this plan, resulting in a situation where the gunner becomes a customer of the farmer, and is directly responsible for the increased income. It follows, then, that the farmer who is being paid to raise game will open his land to controlled gunning.

This brings us back to point 1. Land available for gunning should be posted, informing those who would hunt there that they may do so if they obtain permission of the landowner. Thus the farmer can control the number of gunners on his property at any one time, the net result of the whole procedure being that the farmer will be protected, as he knows how many gunners are on his land, and better hunting will be had as congestion will be relieved and the total number of gunners will be spread over a wider area.

In the case of point number 3, there are two methods which may be followed. The landowner may plant grain to provide food for game, or the state commission may have the work done on areas designated by the owners. In the first case, the farmer must be paid to do the work and must be supplied with rye and buckwheat for quail or corn and cow-peas for pheasants. If the state undertakes the work, a truck and tractor, with plow and disk harrow will be all the equipment necessary to attend to the work over a large area.

That there is plenty of land available on almost every farm that may be used for raising game feed is well known. Every farmer with such land available will be glad to have it plowed and planted, or to do the work himself if compensated for it.

Control of predators is an essential part of any plan for the preservation of wild life. Weasels, cats, and crows, to mention only three of the many enemies of game, account for more dead birds and rabbits in the state of New Jersey than all the gunners combined. Predators are hunting every day in the year, while the gunning season lasts for a period of only a month or so.

The same persons who raise game for the state can be interested in predator control. I have demonstrated that simple traps, properly placed, will soon reduce both winged and furred predators to a minimum.

It could easily be arranged for the state commission to set aside a fund each year to provide a series of prizes to be awarded to the farmer or farmer's son or daughter who trapped the greatest number of predators. The regular state game wardens could check up monthly on the catches, and the annual prizes awarded on the basis of the wardens' report.

I have also found that the egg-stealing propensities of the crow can be used to good advantage in the control of this black-winged thief. Candled incubator eggs can be filled with poison and distributed by wardens to vantage points on poles and in trees where the crows will find them. No crow can pass up the chance to make a meal of eggs, which is the reason why crows play such havoc with game birds. I have practically rid my farm of crows by the simple method of placing poisoned eggs where only crows can get them.

Those who are somewhat familiar with game breeding as it has been practiced will find what appear to be flaws in this system. Quail, for example, cannot be raised in captivity, they will say, except under expert supervision. This was true a few years ago, but I have found by practical experience that it is entirely feasible to set eggs under bantam hens and to raise the baby quail in simply but scientifically constructed coops and runs so that the mortality is reduced to a minimum. Any farmer's boy can, with some instruction, build these coops and runs, and raise quail as successfully as he could raise a brood of chicks. The same thing applies to other game. Instead of trying to multiply the difficulties of game raising, I have found that simplification will yield excellent results. In fact, it is possible, after a little experience, to raise game on a small scale with as little trouble as with any domestic fowl or animal. And who could be better qualified than those who already have this experience?

How does this system fit in with present administrations of game matters? Few if any changes need be made. Present commissions and wardens can adopt this system, if they will only think of game breeding in terms of small units spread over the entire state, instead of as two or three huge game farms that can only inadequately supply game for the gunners.

Present state-owned game farms fit perfectly into the picture. The small game raisers must be supplied with adequate numbers of eggs at proper intervals, and these can be furnished by state owned and operated farms. Thus the efforts of the officials will be concentrated on egg production, and the care of the settings of eggs will be spread over such a large number of raisers that the individual attention needed will be small indeed in comparison with the results.

The whole system briefly outlined here—there are many details that cannot be touched upon at the present time—is not in the least theoretical. Eight years of intensive work have proved each point and demonstrated fully that coöperation between state commissions, the landowner, and the hunter, coupled with the application of scientifically worked-out methods of game raising, will result in better gunning and a greater appreciation of the sport by all concerned.

A fine flock of ring-neck pheasants, artificially raised

Overtones and Atmospheres

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

MANY years ago an old piano tuner showed the writer one of those curious things that most people miss, though the chance to hear it is close to hand. Press down the pedal of the piano, so that the sound of a note may last, and strike one of the lower keys strongly. As the deep bass note dies away its place is gradually taken by the octave, then by the fifth above, followed by the second octave and by a succession of higher tones, each fainter than the last, most though not all of which correspond to higher notes of the keyboard.

The experiment is as pretty as it is simple, and its explanation is easy. Any vibrating system, such as a piano string, can oscillate in many ways. Its principal vibration, with the ends fixed and the whole string moving together, gives the deep fundamental note. But one half may go up while the other goes down, leaving a motionless point in the middle—then we get the octave above. With two fixed points and three vibrating segments comes the next fifth of this octave. With four segments the second octave—and so on. It might be possible by some special device to start the string off in one of these forms and make it give off one note alone. But the blow of the hammer stirs them all up at once, though with unequal intensities. At first the deep fundamental note is so strong that it drowns out the rest. But it dies down rapidly, while the successive higher "overtones" fade out more and more slowly, so that each may be heard for a few moments after its predecessor has died away.

ALL musical instruments produce overtones of this sort—indeed the differences in their intensity are responsible for the varying quality which enables even the novice to tell whether the same musical note has been played on a piano, a violin, or a cornet.

In most instruments, as in the piano, the higher overtones vibrate just two, three, four . . . . . times faster than the fundamental note, and give tones in harmony with it. But in a few, such as bells, this is not the case—which is why a tune has to be played on church chimes one note at a time.

But what have these remarks on the elements of music to do with the heavens, or anything therein? Evidently any parallel must be found in the vibrations of light. But, though physicists sought long for overtones in their spectra, for a long time they found none. We know the reason now: The isolated atoms from which come the spectral lines which are important in the sun and the stars do not behave like elastically vibrating material bodies, but are governed by a quite different set of numerical rules. Molecules give a better chance, for the separate atoms within them may undergo real vibrations about their normal positions. But the band-spectra which are so important in the red stars come from molecules in which an electron "jump" occurs and complicates the effects of the vibrations, which are also present, so that the simple overtones no longer appear.

It is possible, however, for a molecule to absorb or emit light without disturbing the electrons in it, simply altering the state of oscillation of its atoms. In this case there are real overtones oscillating almost, though not quite, as fast as the fundamental vibration. Each of these gives an absorption band in the spectrum of light which has passed through the gas. The main oscillation is very strong and produces powerful absorption. But it is also slow (as such motions go), so that these absorption bands lie far out in the infra-red region and can be studied only with special apparatus and with powerful sources of light. The first two or three overtones also give bands in the infra-red, each much weaker than the last. Higher overtones should give bands in the visible region, but the absorption should be so weak that a very great thickness of gas would be required to produce a perceptible effect.

Till recently, therefore, the investigations of the physicist and the astronomer, though in different parts of the same field, do not overlap. Now the gap has been closed, with notable results. Five years ago (as has already been told in these columns) Adams and Dunham photographed these sharp bands in the infra-red spectrum of Venus. The spacing of the individual lines (which depends on the rotation of the molecule) agreed exactly with that which might be expected from carbon dioxide. But no absorption by this gas had ever been observed in this region, nor could any be found in passing light through 40 meters of the gas, even at three atmospheres pressure.

A FEW months later Adel and Dennison, at the University of Michigan, showed that the strongest of these bands was exactly in the right position for the fifth harmonic (or overtone) of a very strong band which had long been known in the infra-red, while the other two could be equally well explained by a combination overtone involving also another, and slower, known vibration of the molecule. Though the origin of the bands was then proved beyond all doubt, they were not reproduced in the laboratory till the present year. Slipher and Adel have just announced that "by using an absorption cell 45 meters in length, charged with 47 atmospheres of gas," they have been able to detect the strongest of these bands. This corresponds to a layer a mile and a quarter thick, at atmospheric pressure. The

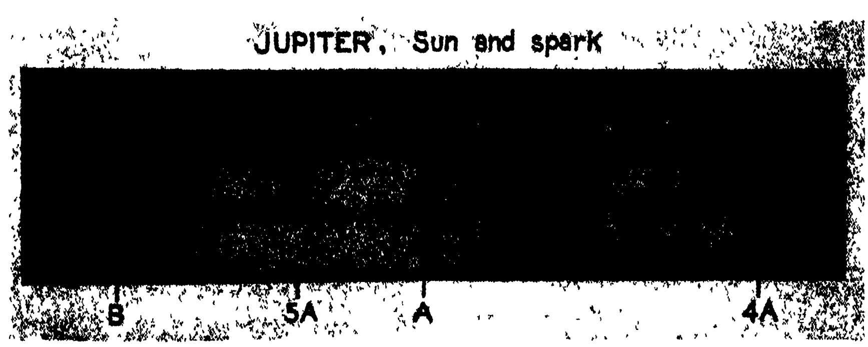


Figure 1: Spectra of Jupiter and the sun, photographed by V. M. Slipher at the Lowell Observatory. This shows the red and infra-red regions, from about 6500A to 9000A. The bands marked *B* and *A* at bottom are due to terrestrial oxygen. The overtone band marked *4A* is very strong. The weaker one marked *5A* is resolved into numerous lines, which in Figure 2 are blended into one band

bands in Venus are stronger, and the amount of carbon dioxide above the planet's visible surface must be at least equivalent to a layer two miles thick at standard temperature and pressure, and may be much more. The amount of this gas alone, in Venus' atmosphere, is at least two thirds of the whole mass of the earth's atmosphere. This seems inconsistent with the textbook statements that the planet's atmosphere is less extensive than ours. But the only previous evidence on this subject was the existence of twilight on Venus, which prolongs the horns of her crescent when she is very nearly between us and the sun. The illuminated layer is little over a mile in thickness, but this represents the part of the twilight on Venus which is so bright that it can be seen telescopically through the foreground of our own atmosphere at mid-day, close to the sun. Only the densest and haziest parts of the planet's atmosphere could be seen under these severe conditions. When she is farther from the sun in the heavens, and can be seen on a dark sky, it might be possible to detect more. Observations indicating the existence of such a fainter and more extensive twilight were made about 150 years ago by the German astronomer Schroter and, strangely enough, seem never to have been repeated with modern telescopes.

THE theory of over-tone bands has had another notable success in the spectra of the major planets. From the dawn of astrophysics, it has been known that Jupiter and Saturn showed bands in the orange region of their spectra, which must arise from something in their atmospheres. Early in the present century Dr. V. M. Slipher found that the same bands were present with greater intensity in the spectra of Uranus and Neptune, along with many fainter ones—as is illustrated in the admirable photographs here reproduced, which the writer owes to Dr. Slipher's generosity.

Wildt, in 1932, pointed out that certain of these bands were probably due to ammonia, and others to methane, and this conclusion was finally established a year later by Dunham, who resolved some of the stronger bands into their component lines, and found that these agreed exactly with the lines produced in the laboratory. But the fainter bands in Jupiter and Saturn, and those which appear only in the two outer planets, remained unidentified.

A few months ago Slipher and Adel announced that they, too, were due to methane. Fuller details, now published, reveal an extraordinary sequence of overtones.

Methane has a complicated molecule, which has no less than four independent types of vibration, each with its own period. One of these gives a strong absorption band in the infra-red, near 33,000 angstroms, and its harmonics account for the heaviest of the planetary bands—marked 4A to 8A in the figures. Another band, near 76,000 A (that is, 76,000 angstroms) is so far out that only its high overtones—marked 11B to 14B—are accessible. Some of these are drowned out by stronger bands. The others, as might be expected, are faint bands. The other bands arise from combinations in which two sets of molecular vibrations are simultaneously stirred up.

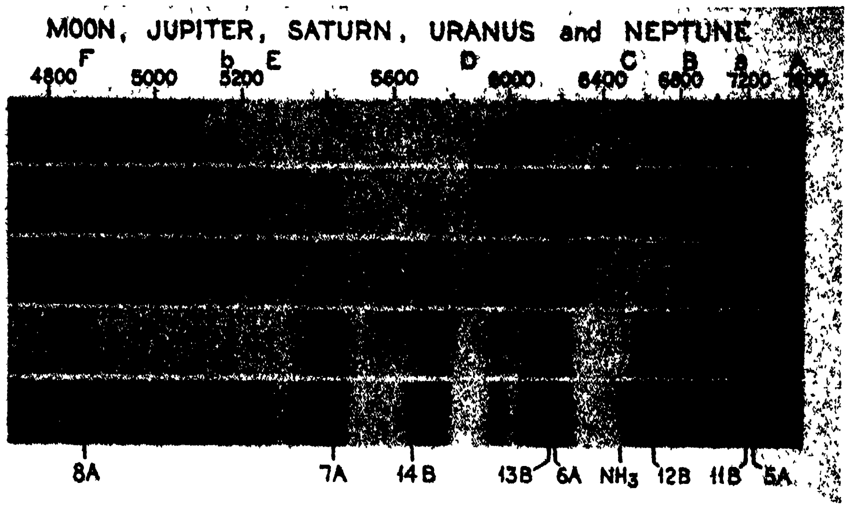


Figure 2: Spectra of the major planets and the moon, photographed by V. M. Slipher at the Lowell Observatory in 1907. The moon, which has no atmosphere, reproduces the solar spectrum. The band marked *B* is produced by oxygen in the earth's atmosphere, and *a* by water vapor. The band due to ammonia is marked NH_3. It is strongest in Jupiter. The bands of methane increase in intensity for the outer planets. The overtones of the great infra-red bands (see the text) are marked at the bottom. The numerals represent angstrom units (abbreviated A) and this piece of the spectrum extends from about 4700 A, in the blue, to 7600 A, in the red. The letters, capital and small, at the top are designations assigned about 1816 to the most prominent lines of the spectrum, by Fraunhofer and, though arbitrary and somewhat clumsy, are still employed by physicists

Practically the whole of this rich system of bands has now been accounted for by a single constituent of the atmospheres. These are faint bands due to ammonia in Jupiter and Saturn (marked NH_3 in Figure 2). These disappear in Uranus and Neptune, presumably because this more easily condensible gas is frozen out by the low temperature.

It is very probable, as Dunham points out, that the clouds which are so conspicuous on Jupiter are composed largely of tiny crystals of frozen ammonia—not drops of liquid; for the measures of planetary radiation indicate a temperature of −132 degrees Centigrade—well below the freezing point of the liquid.

The amount of ammonia necessary to produce the observed bands is estimated by Dunham as equivalent to a layer ten meters thick, at atmospheric pressure. This gives another way of getting at the planet's temperature, for we know what pressure this amount of ammonia would produce by its own weight, under the planet's attraction. The vapor pressure of ammonia has this value at −100 degrees Centigrade. But if, as is probable from other considerations, Jupiter's atmosphere is composed largely of hydrogen, its light, fast-moving molecules help to carry the weight of the heavier ammonia, and the temperature at the cloud level may be as low as −120 degrees Centigrade: in quite as good agreement with the radiometric determination as might be expected.

The great intensity of the methane bands in Uranus and Neptune may perhaps be explained by the freezing out of the ammonia. In Jupiter, and to a less degree in Saturn, there is enough ammonia left to form clouds at a fairly high level and prevent our seeing deeper. If these planets should be cooled down sufficiently, so that no more ammonia vapor was left to form clouds, their atmospheres would become clearer, and we might see much deeper and get stronger bands of methane, as we do in the other planets.

The amount of this gas in the planet's atmosphere must be great. Slipher and Adel find that a layer of methane equivalent to two kilometers, at standard temperature and pressure, produces absorption bands comparable to those in Jupiter and Saturn. The amount in Neptune has not yet been matched in the laboratory, but may be ten times as great, or more.

Since the light we receive from the planets goes twice through their atmospheres—in and out—we may estimate the amount of methane in Jupiter's atmosphere as roughly equivalent to a kilometer, under standard conditions. Under the planet's gravity this would exert a pressure of one-sixth of a stand-

(*Please turn to page* 277)

Construction of the Colorado River

AQUEDUCT SIPHONS

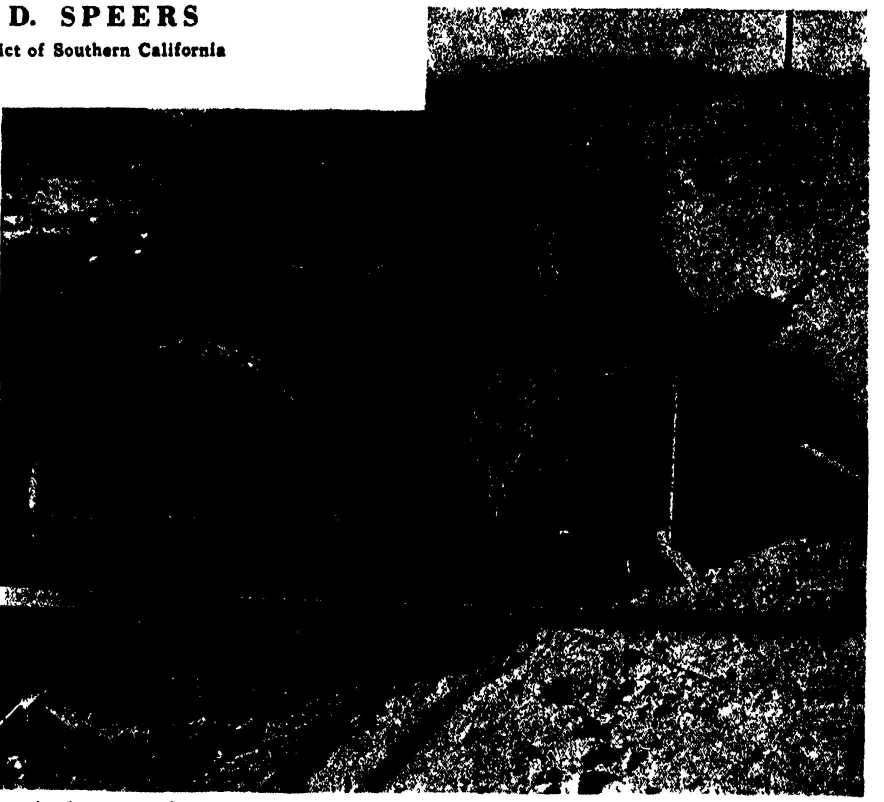
By ROBERT D. SPEERS
Metropolitan Water District of Southern California

WITH underground crews past the one third mark on the largest tunnel excavation program ever carried forward in the history of engineering (see SCIENTIFIC AMERICAN, September, 1934, page 134), construction forces of the Metropolitan Water District of Southern California are now engaged upon still another phase of the Colorado River Aqueduct project—building the huge siphons which will link together the aqueduct's tunnels.

Together, the siphons and tunnels will form important links in the great aqueduct system which will bring Colorado River water more than 300 miles to 13 southern California cities.

In the Little San Bernardino Mountains—in two of the canyons which separate the Coachella tunnels of the aqueduct—an experiment is being conducted to determine the relative merits of the monolithic and pre-cast types of construction for the immense concrete siphon pipes.

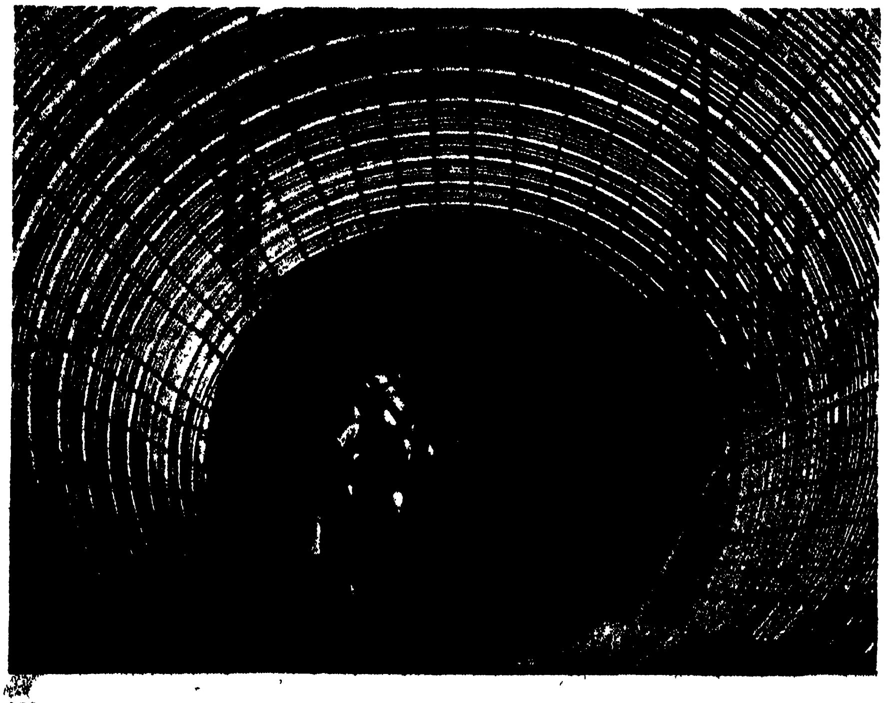
Two inverted siphons are being built. One is the Fan Hill siphon, which is monolithic; that is, it is being poured as one huge piece of masonry. The other structure, the Little Morongo siphon, is pre-cast. It is being poured in 12-foot sections, which are linked together by patented steel joints.



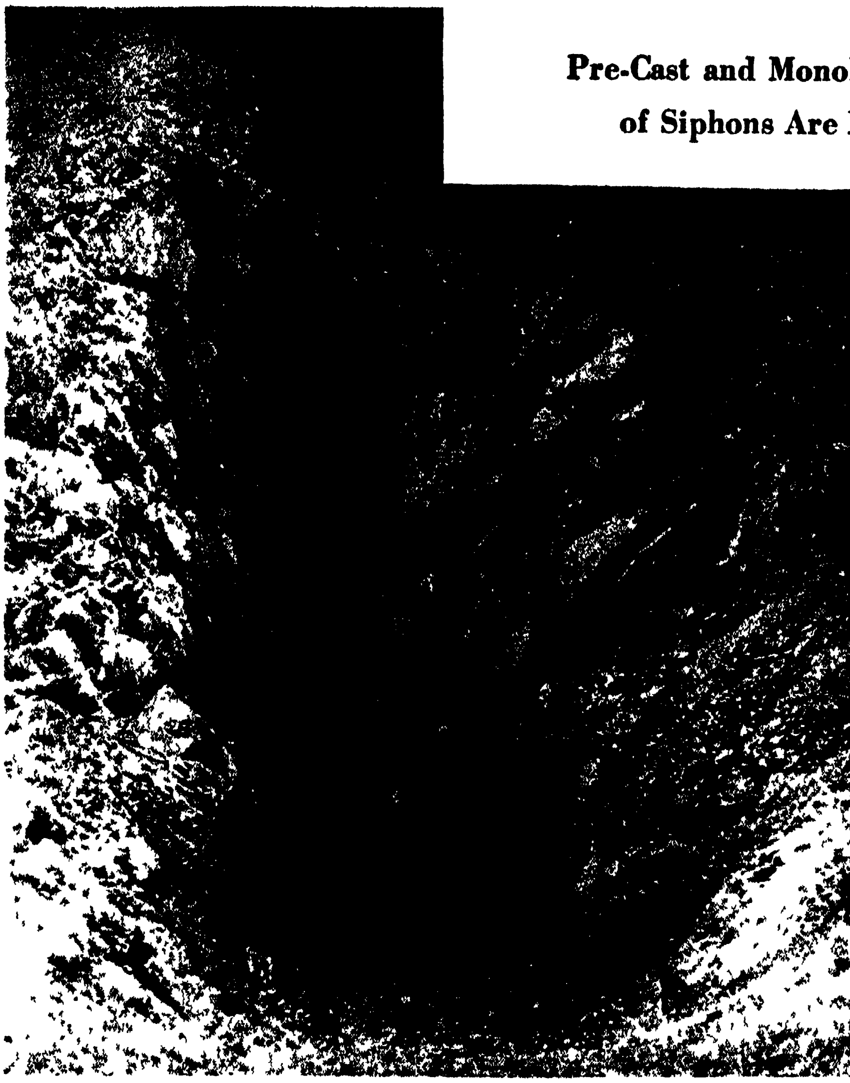
A junction between the siphon tubes and a transition chamber. The chamber extends back for 50 feet, and is constructed of 456 tons of concrete reinforced with 17 tons of steel—a total weight of 473 tons

Careful tests are being made to determine which of these two model siphon sections will be best suited to the rigorous desert conditions under which they will operate. On the basis of these tests, under actual conditions, District engineers will decide which method of construction shall be followed in building the remaining siphons, totaling 27 miles in length, which will carry aqueduct water across declivities in the desert terrain between the Colorado River and Cajalco Reservoir, the terminal storage basin of the aqueduct's main line.

At the outset it should be pointed out that the name "siphon" is, in a way, a misnomer insofar as the aqueduct structures are concerned. They do not, in fact, exert any siphonic action. They act merely as pressure pipes in which the water will find its own level after plunging down to the bottom of one of the desert canyons along the aque-



Steel form within reinforcing rods around which concrete is poured. When one section sets, form is moved on rails and another section poured



Pre-Cast and Monolithic Concrete Types of Siphons Are Now Being Tested

One of the 40-ton pre-cast concrete pipe sections in place in the Little Morongo siphon, showing the steep grade of the canyon wall. Note man clinging to a line just above the mouth of the concrete pipe section

duct line and continuing up the other side. The two ends of the siphons are at almost the same level, the down stream end being slightly lower in order to overcome head loss due to friction in the pipe. The name "siphon" has been applied simply because it is a good descriptive word, the pipes resembling in appearance an inverted siphon.

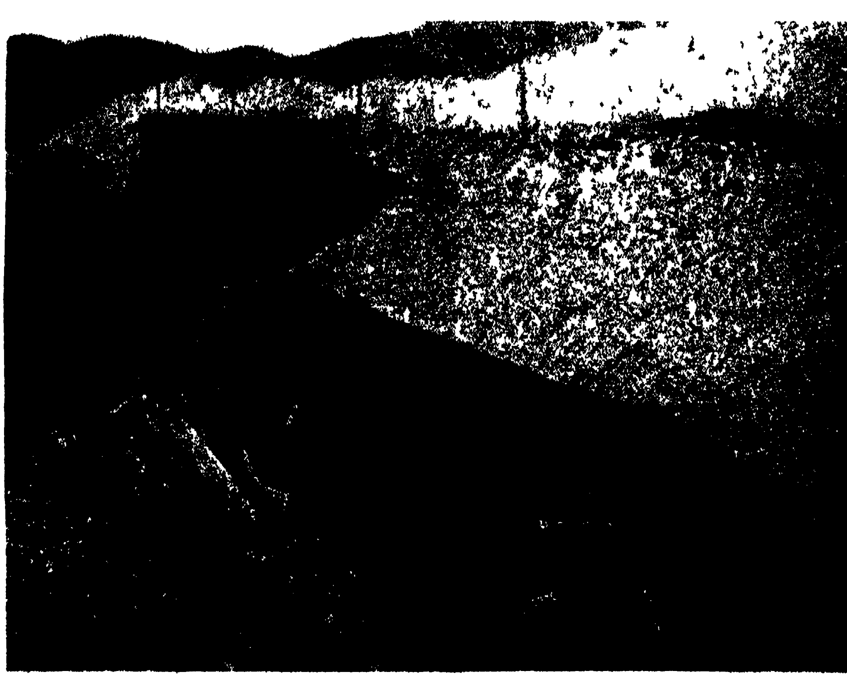
These siphons constitute one of the fundamental differences between modern aqueduct engineering and that practiced by the ancient Romans in the building of their famed water supply systems. Roman engineers drove tunnels and constructed conduits basically similar to those used on the modern aqueducts, but when they came to canyons or valleys which had to be crossed, they were forced to resort to long arcades or trestles to maintain the grade line of their aqueduct. They had no means of building pipes sufficiently strong to withstand the water pressure resulting from a drop into the declivity and the rise on the other side. While highly ornamental, these arcades (in the light of modern construction practice) were uneconomical and poor engineering. They were relatively more costly, and were vulnerable to earthquakes. So the modern aqueduct engineer sacrifices beauty for practicality and safety.

All of the Colorado River Aqueduct's 27 miles of siphons will be built in two separate tubes or barrels, each approximately 12 feet inside diameter. To safeguard the pipes from washouts caused by sudden desert cloudbursts, which are characteristic of the country traversed, they will be laid in large trenches, and buried beneath the bottoms of the washes.

While the tunnels of the Colorado River Aqueduct will be built to full capacity—that is, capable of carrying 1500 cubic feet of water per second—each siphon is being constructed half-capacity, or one barrel at a time. The second barrel will be built whenever demand for water increases beyond half the capacity of the aqueduct. Fifteen hundred cubic feet of water per second amounts to approximately one billion gallons daily.

The construction at Fan Hill includes, as well as the siphon, the construction of the first piece of aqueduct conduit, which links the siphon section with the west portal of the East Coachella tunnel.

Leaving the tunnel, the conduit is in the shape of a gentle arch on top, with a concave bottom inside. Where it joins



Steel inner forms used in building monolithic concrete siphon tubes. This type of movable form is shown in use in a photograph on the opposite page

the circular siphon, it enters a box-like transition section. The work consists of the construction of about 700 lineal feet of monolithic reinforced concrete siphon designed to operate under a maximum hydraulic head of about 45 feet, with a 50-foot concrete transition section at each end. The west end of the siphon is connected with about 700 feet of the semi-elliptical concrete conduit.

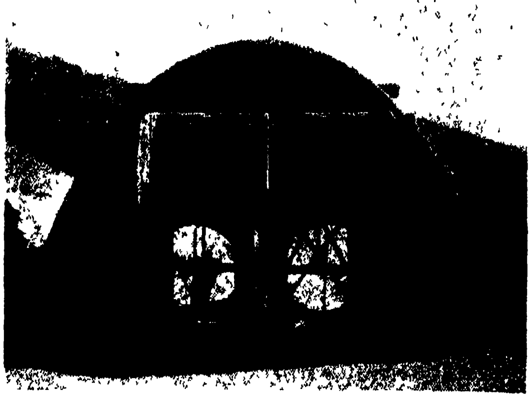
The interior of the siphon section is circular, 12 feet, 4 inches in diameter. The shell is 12 inches thick. The exterior is nearly octagonal. Steel forms are used on the interior and wooden for the exterior. The trench in which the siphon is constructed has a maximum depth of 30 feet. About two cubic yards of concrete are poured for each foot of pipe.

On the conduit, steel forms are used inside and outside. The concrete section is 15 feet high inside, with an overall height of 18 feet, 4 inches. The bottom width is 19 feet inside and 28 feet outside. About four and a quarter cubic yards of concrete are used per foot. Conduit is poured in 70-foot lengths, with contraction joints and water stops each 35 feet.

THE materials excavated from the trench in which the work is being done were tested at the Metropolitan Water District's laboratory at Banning and themselves found to be first class for making concrete. Accordingly a screening and mixing plant has been set up at the site. A unique feature of the job is the placing of the concrete with Pumpcrete equipment, which pumps the mixed concrete into the forms at a rate of 40 cubic yards per hour. (See SCIENTIFIC AMERICAN, November, 1932, page 292.)

An idea of the large size of the transition section may be gained from the following dimensions: 50 feet long; 18 feet, 10 inches high; 28 feet, 6 inches wide across the bottom; contains 456 tons of concrete and 17 tons of reinforcing steel, making a total weight of 473 tons.

Equally interesting is the work on the 720-foot Little Morongo siphon. The word "Little" refers, incidentally, to geography and not to the siphon, which is the largest pre-cast concrete pipe ever made in the United States.


A view of the end of a transition chamber to which a semi-elliptical conduit will be joined

The pre-cast method of construction consists of pouring the siphon in 12-foot sections, each weighing 40 tons, allowing them to cure, and then placing them one by one into the trench.

Ordinarily, pre-cast concrete pipe is manufactured in a factory and shipped to its point of use, there to be assembled. In the case of the Little Morongo siphon, however, the 12-foot concrete sections are so heavy that it is not feasible to ship them even on railway flat cars. Hence, actual pouring and curing of the concrete is done on the ground rather than in the factory. The bar cage reinforcing assemblies which form the cores of the concrete pipe sections are manufactured at Southgate, California, and then shipped into the desert. Also manufactured at Southgate are the huge steel joint rings, 12 feet in diameter and weighing 1000 pounds each, which will link together the 40-ton concrete sections.

After the concrete has been poured around the steel cores of the sections, coal tar is applied to the exterior and water to the interior surfaces. At the end of a seven-day water cure period, a coal-tar coating also is applied to the interiors.

The pipe is laid in a ditch 20 feet wide. Two 60-pound rails are set to line and grade, on concrete ties in the bottom of the ditch. A crane has been erected for placing the heavy pipe sections. The sections are rolled down a ramp to flat cars on the rails in the bottom of the trench, and later lifted from the flat cars into place by the crane.

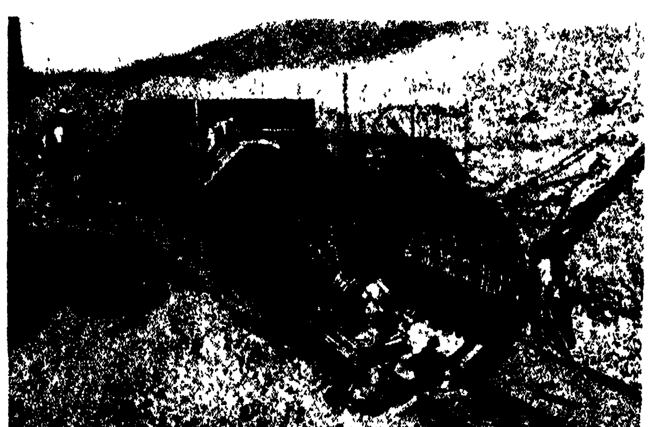
AS has been pointed out, these two siphon sections are already being subjected to extensive tests to determine which type of construction is best adapted to conditions along the aqueduct line. Several months of study must be devoted to the subject before definite conclusions as to final construction can be reached.

Meanwhile, work goes forward rapidly on the other phases of aqueduct construction. Already more than 30 miles of the aqueduct's 91 miles of 16-foot tunnel has been driven through the mountain barriers lying between the Colorado River and the Coastal Plain on which are situated the 13 southern California cities which make up the Metropolitan Water District.

Soon work is to start on the 13,000,000 dollar Parker Dam, from behind which Colorado River water will be diverted into the aqueduct. This structure, to be constructed by the United States Reclamation Bureau with funds furnished by the Metropolitan Water District, will be located about 150 miles down stream from Boulder Dam.

The main aqueduct, from Parker Dam to Cajalco Reservoir, will be 241 miles long, including tunnels, siphons, conduit, and intermediate reservoirs. In addition, 144 miles of huge distributing mains will carry the water from the terminus of the main lines to the 13 cities to be served.


Wood frames used in the first step of building the siphon barrels and transition chamber leading to the conduit


Outside wooden frames and reinforcing steel in place. Within the rods is the form shown on preceding pages

Hauling a net for salmon in Puget Sound

Copper Wire and Fishing Nets

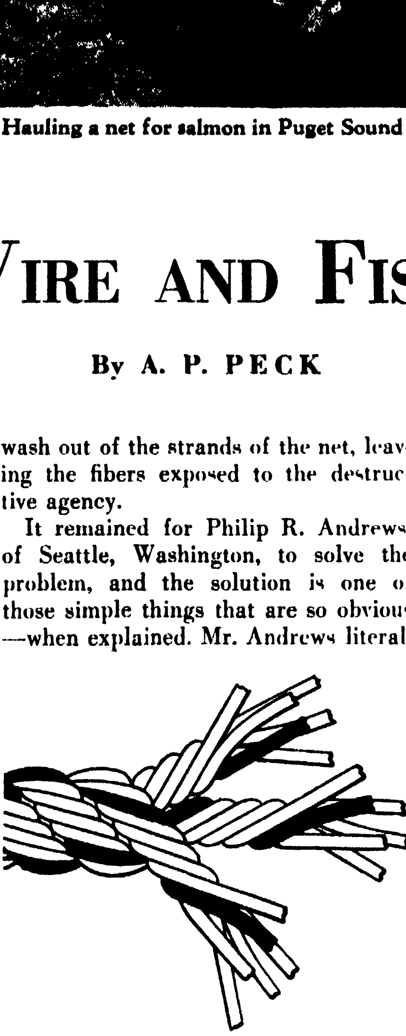
By A. P. PECK

FOR three days a raging northeaster had lashed the surf to a frenzy of pounding white water in which no craft could leave the beach and return safely. At length, a pound net skiff puts out from shore in the cold, dim light of a foggy dawn. The fishing season is well advanced. On setting out, there was no expectancy of a good catch, the sole consideration being the extent of damage which the pound net had sustained. As feared, the net was found badly damaged, in fact almost completely destroyed. The net, incrusted with heavy marine growths and the twine so weakened by the action of micro-organisms, could not withstand the fury of the storm.

Heretofore commercial fishermen on the Atlantic and Pacific Coasts have spent 20 cents for webbing out of every dollar they received for their catch. This high cost of fishing is mainly due to micro-organisms which gather on the nets and not only add to their weight but also digest the fibers of the cotton or hemp strands and therefore progressively weaken them.

FOR years the Bureau of Fisheries has experimented with preservatives and treatments to eliminate or reduce the accumulation of these tiny organisms, but with indifferent success. A coating of tar is helpful but it doubles the weight of the net, makes it difficult to handle, and is, in general, unsatisfactory. Copper and other metallic salts poison the micro-organisms but soon wash out of the strands of the net, leaving the fibers exposed to the destructive agency.

It remained for Philip R. Andrews, of Seattle, Washington, to solve the problem, and the solution is one of those simple things that are so obvious—when explained. Mr. Andrews literally took the ocean into partnership to repel or destroy the animal life and vegetable growths that prey on fishing nets. He hit on the idea of substituting fine copper wires for certain of the cotton yarns which enter into the construction of seine twine and knitting such a twine into a fish net and then letting the ocean do the rest! The natural salts present in sea water react with the copper to form complex metallic salts which completely prevent marine organisms from existing not only on the strands of the net, but also in the water immediately surrounding the webbing.



Copper wire in twine for fishing nets. Black: Wire. White: Cotton

The results gained by Mr. Andrews' invention are manyfold, all of them favorable to the fisherman. "Toxinized" nets, as the copper-fiber combination is called by The Linen Thread Co., Inc., makers of the twine and webbing, are first of all light in weight, being only 25 percent heavier than ordinary untreated nets of the same strength. This compares, to the favor of the fisherman, with a 100 percent increase in weight when tar is applied as a preservative. Then, too, Toxinized nets are clean, easy to handle, need no special care, and at the end of the season are simply dried and stored, ready for instant use when needed. They maintain their strength far beyond the life expectancy of other nets.

THE preservative factor of these nets is always present: As the salts wash out, new ones are generated, keeping the nets free from injurious and weight-increasing growths. It has further been demonstrated that clean nets will yield larger catches, the fish entering Toxinized nets more readily than tarred nets or those heavily incrusted with marine growths.

In the first year after Toxinized nets were made available, many thousands of pounds of webbing have been put into service, with gratifying success. Once more a corner of science has supplied the solution to a problem of industry.

THE ETHER:

RIDDLE OF THE AGES

The Original Concept of the Ether Has Been Altered So Many Times, As a Result of Experimental Evidence Which Has Forced Its Modification, That It Is Now Whittled Down to Next to Nothing. We Still Use the Same Word, "Ether," But the Thing Signified Is Quite Different—Even If An Ether Exists At All.

By CHURCHILL EISENHART
Princeton University. Contributing Editor

THE idea of the possible existence of the ether came of the human need for an explanation of action at a distance. It was not until Newton stated his theory of gravitation that such a need became evident, for in ordinary experience the weight of a body appears to be constant and to be a property dependent only on the body under examination. But Newton showed that weight could be accounted for by considering it as physical evidence of an attraction existing between bodies (that is, masses), and that such considerations, extended to the moon, satisfactorily explained its observed motions. The question now arose as to how this gravitational force acted, since there was no apparent material connection between the earth and the moon through which this force could be propagated, and all actions in daily experience, such as the communication of motion by impact, the transfer of heat, and so on, require material media for their transfer.

The question became: "Can a body act where it is not?" The universal answer in accordance with common experience of natural forces was "No," and therefore in order to unify the nature of forces it was postulated that, although gravitation appeared to act at a distance, it was really conveyed by a genuine medium filling all space, without any breaks or cavities anywhere. No mention was made of the manner in which this medium acted. It was named "the ether," but Newton did not stress its importance, as it was a deduction from, rather than a necessary factor in, the formulation of his gravitational theory.

The next step in the development of the "ether theory" came with the advent of the wave theory of light, as introduced by Huygens and developed by Young. Light was thought to be a wave phenomenon of longitudinal vibration (like sound). Nevertheless, this theory required an omnipresent medium in order to account for the energy received from the sun in the form of light and heat. Light and heat are known to be coming from the sun and stars through interstellar space, and if they are forms of wave motion it was reasoned that there certainly must be something in space which can be thrown into wave movement.

SPECULATION followed as to the nature of this "luminiferous ether," as it was called, terminating in the following description:

It is perfectly transparent—that is, it dissipates no energy; otherwise distant stars and nebulae could not be seen at such distances through space.

There is no friction between matter and the ether; otherwise heavenly bodies (for example, planets) would not continue in their courses undisturbed.

Since it propagates longitudinal wave-motion, it must be fluid-like in nature, and yet it can have no viscosity (fluid friction).

Since it propagates wave motion with such a great velocity (that is, the velocity of light), it must be very elastic.

Such was the state of affairs when Fresnel (1788-1827) announced his researches on polarized light, which proved conclusively that light was a transverse wave motion. This change in the theory of light required a change in the "light bearing ether"; in order to transmit waves of any sort a medium must possess the general property of elasticity, but only the elasticity characteristic of a solid—the elasticity of shape—makes possible the transmission of transverse waves. In other words the ether must be an elastic solid.

The subject of possible relative motions of the parts of the ether was for a while much discussed. It was found, however, that in order to interpret Bradley's discovery (1727) of the aberration of light, and Fizeau's experiment of 1851 (in which it was found that the velocity of light was the same whether going with or against a stream of water), one was obliged to infer that the ether was stationary and did not take part in the movements of bodies, nor was there any relative motion of its parts save the minute deformations corresponding to light waves.

Many were the calculations performed which were to determine the exact magnitudes of the characteristic properties of the ether. Such computations gave to it a density of more than 10,000,000 times that of lead; for, after all, did not the ether fill in the gaps between the most minute of atoms? If so, it must be very dense. Moreover, in order for it to be stationary in the presence of such violent motions as are always going on in it, the inertia (mass) of a cubic centimeter of the ether must be of the order of 10^{12}, that is, one trillion times that of the same volume of water; and, since it transmits a transverse vibration with the velocity of light, it must be a solid of rigidity 10^{33} (for comparison, that of steel is 10^{11}).

Such was the belief of the early 19th Century scientists, who thought they knew the ether as well as they knew matter. This was an excellent dilemma, and there seemed to be no escape. It did not seem possible that light and

heat energy could be propagated everywhere in space without something in which to travel, and yet the necessities of the wave form required imposed the acceptance of a medium which possessed properties totally at variance with everyday experience, and indeed contradictory to sense impressions.

Up to this point physicists had been considering the ether as they would matter, but the results of such a procedure being absolutely at variance with common sense, it was found necessary to conclude that the properties of the ether could not be expressed in terms of units used in the description of matter. Examined from the point of view of mechanical waves the ether had proved intangible, elusive, and "beyond the reach of human intuition." The all-pervading ether had been *postulated* in order to explain gravitation, and in a similar manner it had seemed necessary for the interpretation of light and heat phenomena; but in both of these cases it had been invented in order to aid in a mechanical explanation of these phenomena. It had served its purpose in simplifying theories, but was itself most elusive. Apparently the ether itself could not be truly visualized when viewed in a mechanical way.

MECHANICS having failed, attention was now turned to the field of electricity and magnetism. The introducer of the ether in this branch of physics was none other than the celebrated Michael Faraday. Up to his time a more or less intangible something called a charge had been thought to exist on a charged body, and this something apparently exerted forces on other charged bodies at a distance, in much the same way as gravitation acted on massive bodies. In fact, the mathematical relationship for the force between the charged bodies had been determined. Nevertheless, the idea of action at a distance was distasteful to Faraday. Maxwell, in the preface to his "Treatise on Electricity and Magnetism," says on this subject: "Faraday, in his mind's eye, saw lines of force traversing all space, where mathematicians saw centers of force acting at a distance: Faraday saw a medium where they saw nothing but distance: Faraday sought the seat of the phenomena in real actions going on in this medium."

To Faraday the intervening medium transmitted the electrical force in a way similar to the transmission of an elastic deformation by a rod. Moreover, since electrical forces act through a vacuum, Faraday assumed that the transmitting medium was the ether and considered its properties to be modified by the presence of matter in order to account for the reduction in magnitude of the electric forces acting between charged bodies, when matter such as glass was interposed. In like manner, the ether was thought to account for magnetic phenomena. At this point the miraculous happened: Faraday produced rotation of polarized light with a magnetic field, and a little later Kerr produced a similar rotation with an electrostatic field, thereby suggesting that the phenomena of light, electricity, and magnetism are all propagated by the same medium—the ether.

Inspired by the work of Faraday, Maxwell set to work with mathematical equations and was able to show "that if a medium such as Faraday postulated actually existed, it must be possible to produce in this medium periodic vibrations of the electric and magnetic field intensities having all the characteristics of waves." A short while later Hertz succeeded in producing such electromagnetic waves, and proved that they were identical with light, the only difference being in wavelength. His work seemed firmly to establish the ether, and its purely mechanical aspect was abandoned to one possessing electric and magnetic properties. The reaction against the mechanical was a little too extreme, however, and we find Hertz considering matter and ether as the same—the former being a modification of the latter. He had been led to this belief by the fact that apparently his electromagnetic waves passed through many kinds of matter undisturbed.

Hertz, who actually produced the waves that Faraday had postulated

Such was the state of affairs when Lorentz stepped into the field. As a result of his calculations the theories then prevailing were brought into accord with experience: the ether was devoid of its mechanical properties as before, and matter was stripped of its electromagnetic characteristics. For example, the electromagnetic properties of matter[1] were not attributed to the atoms themselves but to the ether which surrounds and permeates the atoms. Such a theory admirably accounted for the diminished intensity of light on passing through even the most transparent bodies[2]; also it accounts for the observed increase in absorption of electromagnetic radiation with increase in density (for example, lead is used to absorb X rays). The only remnants of the old mechanical ether left were the property of immobility—a property which seemed to be in accord with the experiment of Fizeau, the phenomena of aberration, and, more recently the experiments in electrodynamics of H. A. Wilson on the force produced by moving an insulator in a magnetic field. (*Proceedings of the Royal Society:* Vol. 73 [1904]; 490.)

Today the ether has ceased to take an active part in electromagnetic theory; a writer on the subject generally postulates its existence and states that "at any point in it there is an electromagnetic quantity having magnitude and direction whose intensity can be measured,"[3] and from that moment on discusses the properties of this quantity, never again mentioning the ether itself. This quantity is supposed to represent some condition of the ether, but "the ether is now only a background and not an active participant in the theory."[3]

SINCE the ether appeared to be stationary it seemed reasonable that one ought to be able to determine the velocity of the earth through it. Now the relative motion of one body with respect to another is all we can ever observe. But how to observe the relative motion of the earth with respect to the stationary ether? Light is supposed to travel in the ether, and therefore a ray of light sent in the direction of the earth's motion through the ether ought to be retarded.

In order to check this, Michelson and Morley constructed an apparatus with two arms perpendicular to each other; by means of reflecting surfaces a single beam of light was broken up and one part sent down one arm of the apparatus, and the other part down the arm perpendicular to the first; after each beam had been reflected back and forth, each in its own arm of the apparatus, the two were brought together in the same observation telescope by means of reflecting surfaces, the distance traveled being the same in each case. In each of the above cases the beam of light was sent over its course and back upon itself and therefore interference must result, giving in the telescope a definite set of interference fringes. Any altera-

[1]Property of transmitting light, electricity, magnetism.

[2]That is, the light which a body transmitted was said to have passed through the ether-filled gaps between the atoms.

[3]A. S. Eddington, in "Space, Time and Gravitation"

tion in the speed of light along either arm must manifest itself in a shifting of these two sets of interference fringes with respect to each other.

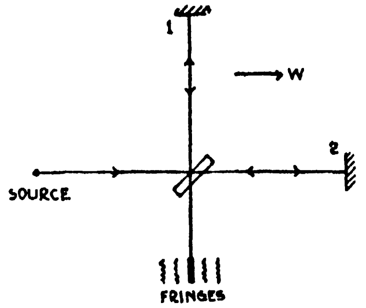
As in the case of a boat rowed upstream and back, or across stream and back, the ray of light which happened to be traveling in the direction of the earth's motion through the ether should be retarded on its trip so that it would return to the telescope later than a ray sent on a trip at right angles to this direction. Of course, it was not known which way was with the earth's motion (and the earth certainly does move, as can be shown by astronomy), and which was transverse, but observations were taken with the apparatus set in all possible directions, and at different times of the year. Hence an effect should have been noted, but no retardation was observed.

What could be the trouble? Naturally the first question asked was: "Had the apparatus sufficient sensitivity?" The universal answer was "Yes," for the apparatus had been constructed in such a manner as to be capable of observing a much smaller motion than the known motion of the earth about the sun. Michelson was led to believe that the ether was carried along with the earth, thus accounting for the absence of an ether breeze.

THIS theory was, however, at variance with the phenomena of aberration, Fizeau's experiment, and the researches of H. A. Wilson. Moreover, Sir Oliver Lodge carried on an equally exact experiment, regarding which he says: "I whirled steel disks at a great rate till they nearly burst, and sent light round and round between them, that way round and this way round, and compared the time taken to go round with the disks with the time required to go against the disks; for, if the ether had been carried around with the disks, the beam one way would have been accelerated and the other way retarded. There would have been an effect. There was no effect. This proved that the ether and matter are mechanically independent of each other; matter moves through the ether without the slightest resistance, and its motion does not affect the velocity of light in the neighborhood."

These experiments, entirely contradictory, presented a difficulty from which it seemed difficult to escape. It was at this point that Einstein stated his Special Theory of Relativity, the kinematics of which was modeled on the Maxwell-Lorentz theory of the electromagnetic field, and hence the Relativity Theory (Restricted Sense) was in agreement with the electro-magnetic theory. The Special Theory of Relativity assumes, on the basis of the above experiments, that the velocity of light is constant regardless of the motion of the observer, and shows that the laws of nature (that is: those of mechanics, light, and so on), are of exactly the same form when referred either to a system of coordinates relative to which the ether is at rest or to a system which is moving uniformly (not accelerated) with respect to the former.

Since by the Special Theory, the equations governing the laws of nature hold equally well for a system which is moving in uniform translation relative to the ether, why give a preferred distinction to the stationary system when all the uniformly moving systems are physically equivalent to it in all respects? Therefore, if the ether is still to be considered as existing, which is not at variance with Special Theory, then all its properties which depend on its having a definite state of motion must be given up; in other words, *the ether has now lost the last of the mechanical characteristics that it formerly possessed*—immobility.



The famous Michelson and Morley experiment described in the text

The ether has never been proved a reality. It apparently has no properties common to experience, and from the point of view of Special Relativity it seems to be an unnecessary hypothesis.

Therefore, why not do away with the ether? Because "to deny the ether is ultimately to assume that empty space has no physical properties whatever, and the fundamental facts of mechanics do not harmonize with this view."[4]

For example, the mechanical behavior of heavenly bodies depends not only on their relative positions (distance from each other) and relative velocities, but also on the states of their rotation and acceleration, and in order to be able to discuss rotation and acceleration as something real there must be something other than the observable object by which to reckon acceleration or rotation. In reference to real things, Einstein said, in *The New York Times* (February 3, 1929): "Matter is real . . . motion, space, and also time are real forms. Every attempt to deny the physical reality of space collapses in the face of the law of inertia. For if acceleration is to be taken as real, then that space must also be real within which bodies are conceived as accelerated."

Attempts have been made by Mach and others to eliminate the ether by substituting in its place a "mean acceleration with reference to the totality of the masses in the universe."[5] But, in order to have inertia producing an effect on the relative accelerations of distant masses the old action at a distance creeps in again, and in order to account for this, an ether has to be postulated to serve as a medium for the effects of inertia. Such a medium not only determines the behavior of masses, but also has its properties determined by them.

THIS leads directly to the ether or space concept of the General Theory of Relativity. According to this theory the nature of the ether in a *space-time* interval varies at different points in the interval and is subject to influences of matter existing outside the interval under consideration. Since, in accord with this theory, space is neither homogeneous nor isotropic (same physical properties in every direction), its condition in a particular interval being given by ten functions called gravitation potentials, one can no longer consider it as empty. Therefore it contains an ether, it is true, which no longer possesses any mechanical or kinematical properties, but which *helps us to understand* and determine mechanical and electro-magnetic events.

In conclusion, to quote Sir Oliver Lodge: "It is quite true that physical calculations and discoveries can proceed without explicit reference to the ether, but when we come to philosophize and try to formulate the facts physically, it is clear that space must be endowed with physical properties, and is, therefore, entitled to something more than merely a geometric name."

[4]Einstein in "Sidelights on Relativity"

[5]Einstein in "Sidelights on Relativity"

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ASTRONOMICAL PHOTOGRAPHY

A Specialty for the More Advanced Amateur Worker

By JAMES STOKLEY
Associate Director, The Franklin Institute Museum, Philadelphia

Photographs courtesy Yerkes Observatory

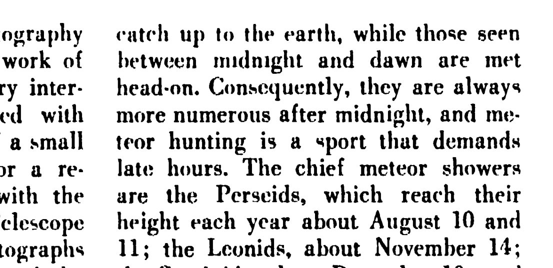
Meteor trail accidentally caught on plate while exposing for stars

THOUGH astronomical photography forms a vital part of the work of the great observatories, very interesting results can be obtained with simple apparatus. The owner of a small telescope, either a refractor or a reflector, made in accordance with the instructions in "Amateur Telescope Making," can easily make photographs with it of the sun, the moon and the brighter planets and stars. A very valuable guide is "A Manual of Celestial Photography," by the late Edward Skinner King, of the Harvard College Observatory.

Even the owner of an ordinarily good camera can make star photographs without any other equipment. On a clear, dark night, the camera should be set up on a firm support, pointed to the northern sky, and a time exposure of several hours given. When the film is developed, it will show a number of arcs of concentric circles. These are the trails of the stars as they apparently circle around the north pole of the sky. The stars seem to move around the pole in a counter-clockwise direction, and if you mark the ends (or the beginnings) of the trails, you will recognize the familiar constellations of the northern sky. If the camera is pointed toward another part of the sky, the trails will be straighter than those near the pole.

When, as may happen, a bright meteor, or "shooting star," happens to go across the sky within range of the camera, it will leave its own trail. At certain times of year, when the earth passes through one of the various swarms of meteors, shooting stars are particularly numerous. Instead of seeing one or two an hour, the average on an ordinary night, you may see them at the rate of one a minute, or even more. Because of the way the earth turns, the meteors that we see before midnight have to catch up to the earth, while those seen between midnight and dawn are met head-on. Consequently, they are always more numerous after midnight, and meteor hunting is a sport that demands late hours. The chief meteor showers are the Perseids, which reach their height each year about August 10 and 11; the Leonids, about November 14; the Geminids, about December 10; and the Lyrids, about April 19. These are named after the constellations from which the shooting stars seem to radiate.

So on these nights, set up your camera about midnight, pointed to the east, in the general direction in which the constellation will rise. Proceed in the same manner as for the polar star trails, but it will be better to take several different exposures, letting each one continue during a half hour period. If any particularly brilliant meteor, especially one bright enough to illuminate the landscape, should appear, note the time, and stop the exposure then. But change the film, or plate, as quickly as possible, in order not to lose any. Of course, the faster the film and the lens, the more faint meteors you will catch. With super-speed panchromatic film, and a modern fast lens, working at an aperture of $f/2.7$ or higher, one should have pretty good results. Such photographs may be of real scientific value, and those astronomers who specialize in the study of meteors will be glad to receive them, and any other amateur meteor observations. Dr. Charles P. Olivier, at the University of Pennsylvania, Philadelphia, is president of the American Meteor Society, an association of amateurs, and Dr. C. C. Wylie, at the University of Iowa, Iowa City, Iowa, is head of the Midwest Meteor Society. These astronomers specialize in meteors.



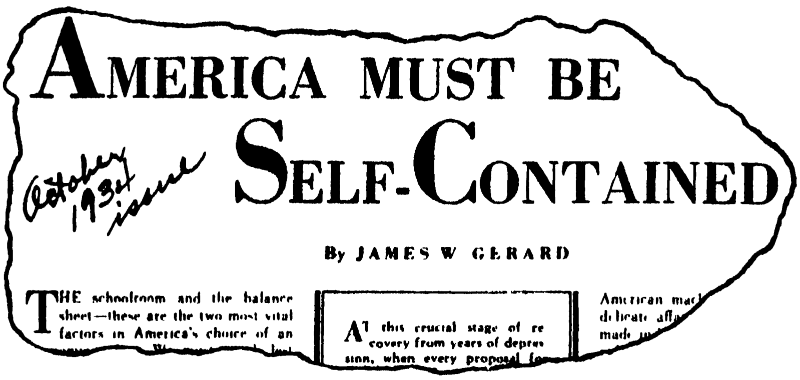
***Left:* Star trails at or near the celestial equator. *Right:* Circumpolar trails at the celestial pole**

If the moon is in the direction the camera is pointed, it will also leave a trail, far brighter, probably blotting out all the stars by its glare. The moon is bright enough to permit a snapshot to be made, half a second perhaps, and in this time it will not have moved appreciably. But the image will be very tiny, not more than a twentieth of an inch in diameter, and it will be difficult to find any of the familiar details.

IT is possible to take a larger picture by fastening a pair of binoculars, or even a pair of opera glasses, to the front of the camera, using one side but not the other. In doing this, be sure that the lenses of the glasses are exactly in line with that of the camera, otherwise there will be distortion. The only way to determine the focus is by experiment. Probably it can be found approximately by the use of a ground glass, the camera pointed either at the moon itself, or at some very distant object in the daytime. To get it more exactly, take a series of photographs of the moon, changing the focus ever so slightly between each. The enlargement of the image, by means of the glasses, also has the effect of spreading the light over a larger area, and so the exposure will have to be longer than if the camera were used by itself. However, the moon moves its own diameter across the sky in about two minutes, and if the exposure is longer than about five seconds, the motion will cause a blurring of the lunar details. With fast films an exposure of less than this should be adequate.

RAYMOND B. FOSDICK refutes

MR. GERARD'S DREAM


AMERICA MUST BE SELF-CONTAINED

October 1934 issue

By JAMES W GERARD

THE schoolroom and the balance sheet—these are the two most vital factors in America's choice of an

AT this crucial stage of recovery from years of depression, when every proposal fo

American mac delicate aff made

Not Organized for Self-Containment.

15,000,000 People in Foreign Trade.

Where "Isolated Prosperity" Leads.

Can Not Live by Slogans Alone.

Spread-Eagleism.

Machines Create Interrelationships.

War and Nationalism.

Nationalism Merely Discouragement.

A Panic Remedy.

MY friend, Mr. Gerard, is indulging himself in some wishful thinking. Confronted by a chaotic economic world, he builds a fanciful Utopia in which he finds peace—and escape. It is all so simple as he pictures it. Foreign markets have given us nothing but trouble—why bother with them? Let us sell only to ourselves, producing what we need and consuming it within our own national boundaries. In so far as necessities like coffee, tea and silk are concerned, let us put these minimum requirements on a bookkeeping basis, "so that our dealings with every nation can be perfectly balanced." But otherwise, let us free ourselves from world price fluctuations, retire behind tariff walls, presumably higher than they are now, and live out our days in peace. Thus do children build retreats under a table or in a treetop to escape the realities of an adult world.

The trouble with Mr. Gerard's idea of a self-contained America is that it refuses to face a very stubborn fact. And this fact is that the American economic system is not organized for self-containment. As the result of a long and painful process of evolution our producing interests, both in agriculture and industry, are adapted to world markets. Any attempt to reverse this trend and unscramble this process would result in chaos and human misery on an incalculable scale.

FOR example, suppose we try to reduce American agriculture to a self-contained market. What is involved? We must be prepared to retire permanently from 40 to 100 million acres of crop land. This is the official estimate of the Department of Agriculture of the curtailment necessary to bring our crop production down to the level of our home demand. And what does it mean to take from 40 to 100 million acres out of productive farming? It means that whole populations must be transported out of the farming areas—and where will we take them? It means, as Secretary Wallace points out, government control of marketing, licensing of ploughed land, and base and surplus quotas for every farmer for every product for each month of the year. In the words of Secretary Wallace, "every ploughed field would have its permit sticking up on its post"—and we would be launched on an era of governmental regulation and regimentation as drastic as anything that Russia has dreamed of. It is well that Mr. Wallace asks the question whether the American people have the resolution and staying power to swallow all the traditions and deeds of our robust, individualist past, and submit to a completely army-like, nationalist discipline in peace time.

Or let us suppose that we try to bring American industry within the limits of America's purchasing power. What is involved here? The displacement of labor and loss of capital on an unprecedented scale. In 1928 it was officially calculated that two and a half million families were dependent upon industrial production for export—perhaps ten to fifteen million people altogether. What does Mr. Gerard propose to do with these people? How does he plan to take care of them? Does he really think that home consumption can be increased to meet the needs of this vast army? The present situation is none too happy, but if we throw up our hands in despair and admit that foreign markets are definitely lost and international trade is dead beyond resurrection, we are saddling ourselves and the future with a permanent body of unemployed, a permanent dole system, permanent governmental regimentation, and all the social deterioration and dry rot that accompany an economic order which cannot find work for its people.

THOSE who are dreaming of a self-contained America have not faced the consequences of their proposals. They want to have their cake and eat it too. Mr. Gerard talks about a "return to that security which we sacrificed"—in other words, going back to the good old days, presumably to the days before the federal government began to exercise some measure of control in the management of business. Listen again to Secretary Wallace:

"As yet we have applied to this country only the barest beginnings of the sort of social discipline which a completely determined nationalism requires. . . . Our own maneuvers to date have been mildly persuasive and democratic. . . . If we go on trying to keep things whirling within nationalist limits, it

seems certain that we shall count less on social discipline voluntarily aroused and more on direct compulsion. Under such circumstances the traditional American spirit would soon be, it seems to me, as a spring, tightly coiled, and ready to burst out dangerously in any direction."

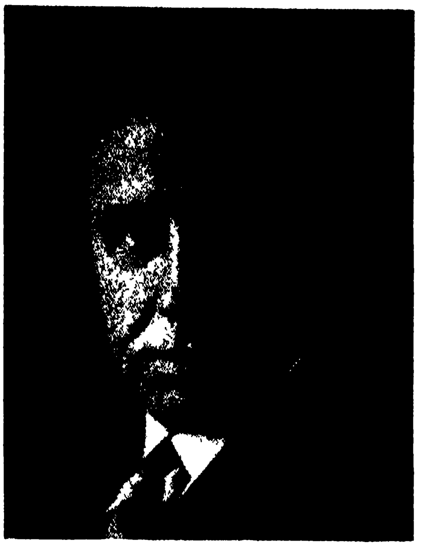
Before we start on the path of isolated prosperity, it would be well for Mr. Gerard and his friends to consider where the road leads. Not very far ahead we shall be confronted by the sign posts that point to Fascism or Communism. Are we ready to make the choice?

Quite apart from the consideration of what is involved in getting to where Mr. Gerard wants to go, there is the question of why, on broad grounds, anybody would believe that a self-contained national status represents a good way of living. To be sure there is a patriotic flavor about the slogan "America Self-Contained," just as there is a patriotic flavor about the words, "Buy British," or "France for Frenchmen," or "Deutchland Uber Alles." But men cannot live by slogans alone. Too often these catch-phrases are substitutes for thinking. Too many times they are respectable screens for the emotion of the pack.

SO with this idea of a closed national economy, it appeals to the spread-eagleism that is always latent in every country. It easily attracts the applause of the patriotic loud-shouters. Only occasionally does it gain any measure of support from a Keynes, a Donham or a Stuart Chase.

But, assuming that it would be possible to achieve this goal, what kind of human civilization does it imply? Does Mr. Gerard believe that a chromium steel wall one mile high around the boundaries of the United States—to use Stuart Chase's illustration—would make for a better, saner life inside the enclosure? If this were true of the United States why would not happiness and prosperity be increased in California and Louisiana by the same walled-in process? And would it not make for greater satisfaction if we New Yorkers, like Mr. Gerard and myself, could similarly isolate ourselves from the critical judgment of the rest of the country?

These questions are of course fantastic. The groupings of mankind—whether in nations, states, cities, communities or families—are today interrelated and interwoven in a complex pattern that would have seemed incredible a hundred years ago. This is what our machine civilization has done to us. It has reached out with gigantic hands to compress time and space within a small compass, and the process has brought into existence new procedures and institutions and a new principle of human integration. It has developed a high degree of specialization not only between different areas of the same country, but between different nations, each unit contributing to the whole. There is a best place and a second and a third best place in the world for the production of everything that men use —whether it is films, wheat, cotton, copper, coal, oranges, sugar, coffee or what you will. That the present plan is haphazard and faulty no one in his senses will deny. But how can any one in his senses believe that the cure for the present evils lies in a return to the small producing units and the narrow divisions that characterized human society before the Industrial Revolution?



Raymond B. Fosdick

For better or for worse here we are—with our machines piled high about us, our airplanes, telegraphs, automobiles, railroads and high-speed productive processes. These new tools involve a new method of living. They have introduced us to our neighbors with whom we must live as best we can. They have broadened our contacts so that our interest and curiosity now range far beyond the parochial limitations of our forefathers. Not only in relation to our physical needs but in relation to our mental needs does this new interrelated civilization play a vital part. Spiritually we cannot go back to the water-tight divisions, to the narrow loyalties, to the little sectarianisms that characterized the old way of life. A new and wider trail has been blazed; and while there will undoubtedly be an occasional loss of direction, as there is at the present moment, the trend toward a world economy and a planetary consciousness is too definitely under way to be permanently reversed. There will be plenty of advisers like Mr. Gerard to bid us return to the old faiths, but humanity is now armed with new tools and has started a march toward a new goal.

One final point in relation to this America Self-Contained movement deserves consideration. Mr. Gerard seems to think it will keep us out of trouble, and that behind our tariff walls we can avoid war. But does anyone seriously believe that peace is the logical result of splitting the world up into intensely nationalistic divisions? In the last few years a fanatic type of nationalism has been bred on the continent of Europe, and countries like France, Germany, Poland and Italy are following its illusive gleam. Not only is the dove of peace conspicuously absent, but Europe is today closer to war than she has been since the signing of the Treaty of Versailles. Nor is this a surprising consequence. It arises from the very doctrine that Mr. Gerard is preaching: the doctrine of economic self-sufficiency. For there are not more than two or three countries in the world today that have either the raw materials or the producing facilities to take even the beginning of a step toward economic isolation. What is to become of the others? Are they to starve to death outside the respective chromium-walled retreats of the favored few? Are the Belgians to eat their lace? Is Ireland to build houses out of bog-peat? Must the Italians burn their fruit trees for lack of coal? Must the Austrians miserably perish wanting everything? The truth is, if denied access to what they need as a means of survival, these less fortunate countries will fight for their existence. There is not a nation in the world today that, if deprived of the right to live, would not bring down the whole house of cards in a last desperate effort to survive. It is the self-sufficient ambitions of those nations that either have "enough," or are determined to get "enough" at the expense of their neighbors, that is arousing jealousy and hatred, and paving the way for violence.

THE way of international understanding and co-operation is a discouraging path to travel. It is an open question whether even by this road we can escape catastrophe. But if the human race is set on bigger and better wars in the future, Mr. Gerard's national self-sufficiency is guaranteed to produce results.

The trouble with Mr. Gerard is that he is discouraged. Because international trade is depressed, he thinks it has disappeared for good. Because the feeble gestures which the nations have made toward a world economy have gotten us nowhere, he believes that nothing in that direction will ever succeed. Because America is hard hit by the depression, he is frankly frightened, and is urging secession from the common interests of the race. But his remedy is a panic remedy. The idea of every nation for itself and the devil take the hindmost is not born of cool-headed judgment. In such a mad stampede for safety the strongest is apt to be trampled down.

The excavated temple foundation. Various objects found have been left in place and standing on the soil beneath them, while the excavation was carried down deeper. Note fire pit in center

Tennessee Valley Authority Aids

AMERICAN ARCHEOLOGY

By GEORGE O. GILLINGHAM

THE site of one of the early fortified villages of the Cherokees has been discovered just outside of Careyville, Tennessee, by archeologists of the Tennessee Valley Authority, in their examination of Indian remains in the area to be flooded by the waters of the Norris Dam reservoir. Major W. S. Webb, head of the Department of Anthropology and the University of Kentucky, has been "loaned" to the Authority for the work.

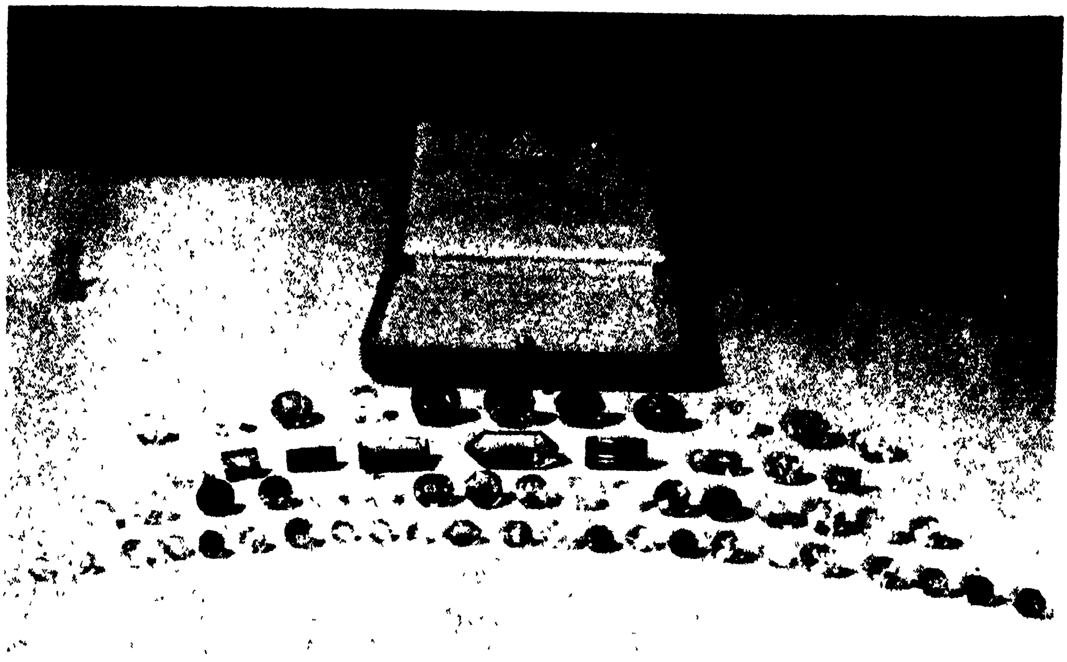
The foundations of the village temple, council room, a private dwelling, and a portion of the stockade that surrounded the town, have been brought to light. Further excavation below the level of the hard-packed clay floor of one of these revealed the foundation of another temple, marking an even earlier occupancy of this particular spot by the Cherokees. These are the first temple sites found east of the Mississippi.

The temple foundation measures approximately 30 by 40 feet, and has a raised baked clay altar with a fire pit in the center. The walls of this building were thatched and about 10 feet in height. The roof was formed by bending the tops of the young trees that formed the solid part of the wall inward toward each other and binding them together, thus forming an arched roof. This, too, was thatched. The semi-public building that stood near the temple was of the same construction, but had only a flat fire pit in the center, rather than a raised temple altar. The private dwelling house, typical of the dozens that must have formed this village, covered a space 15 by 18 feet and was constructed of much smaller poles. Along the edge of one wall is a raised clay bank which no doubt served as a seat for the tribal head. In the center is a small fire pit.

Raised clay bank in private house which probably served as a seat

The post holes marking the location of the stockade indicate that tree trunks at least 10 inches in diameter were used in the fortifications. This huge fence occasionally took abrupt right-angle turns, in order that the face of the stockade could be protected by a cross fire of arrows. The gateway had a protecting wall of poles in front; thus no person entering or leaving would be in a direct line of fire from an enemy. It is thought that this Careyville site may be the Cherokee fortress that Colonel Montgomery saw and thought too strong to attack during his invasion of Cherokee territory in colonial times.

ON the T. B. Walters farm along the Powell River, excavation has brought to light a small burned dwelling, 11 by 11 feet in size, with the customary fire pit in the center. In this site were found four clay vessels still intact, measuring about six inches in diameter, the remains of a larger pot of about 12 inches diameter, and small round stone counters, like checker pieces, which were used in an early Indian game. The pottery, like all early American ceramics, is of the coiled type of manufacture, as the potter's wheel was unknown to the American Indian. It is unpainted and without design, except a serrated ridge around the edge of some of the bowls. The larger pots were no doubt fitted with handles, as several clay handles have been found.



Faceted gems cut by the author. They include topaz, aquamarine, beryl, and tourmaline

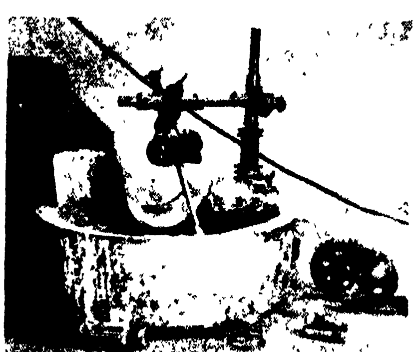
Faceted Gems for the AMATEUR LAPIDARY

By ARTHUR KNAPP

IN the March, 1932, number there was an article by J. H. Howard, entitled "Gem-stone Cutting for the Amateur," which introduced a new hobby to our readers. This hobby attracted a small but select following. In March, 1933, we reproduced photographs of some of the "cabochon," or rounded, gem work done by Mr. Howard's followers. We now show some of the work done by a Philadelphia amateur who has progressed to the more difficult faceted work. The raw materials for this hobby are not expensive when obtained in the rough and the enticing picture at the top of the page should make more of the readers wish to become amateur gem cutters.—*The Editor.*

IT may never have occurred to the reader that it is possible for an amateur to cut and polish worthwhile semi-precious faceted gems. All that is needed is a fair degree of mechanical skill.

It is advisable to learn the fundamentals by cutting and polishing the rounded cabochons first. There is a certain amount of technique which is much easier to learn with a rounded surface, and there is a certain amount of education in looking at and judging wet, polished surfaces, which can be gained only by such experience. The only book on the subject known to the writer is J. H. Howard's "The Working of Semi-Precious Stones." This book contains all the information necessary to get started.



Simple rig for gem-stone cutting, driven by a small electric motor

The machinery required for cutting faceted gems is very simple, and may be constructed in the home. All that is necessary is a motor-driven vertical shaft. The writer uses a one half inch drill rod steel shaft and two self-aligning bearings. On the top of the shaft is a threaded arbor for holding the lap disks.

Cutting is done on a disk or lap of soft gray cast iron, using Number 600 fine Carborundum. Polishing is done on a lap of block tin, oxide of tin being the usual polishing medium.

THE rough gem is attached, by means of a special wax, to a short metal rod which is screwed into the center rod of the index head (see illustration). The index circle has 32 slots, and controls the position of the facets around the gem. The vertical angle is controlled by placing or removing slotted washers on the vertical shaft, to raise or lower the horizontal arm. Since cutting is done on one lap and polishing on another, it is necessary to have exact mechanical control of the position of each facet, in order that they will register precisely on the polishing lap.

The stand, clamps, and bushings of the indexing machine are standard parts. The index plate was cut on a gear-cutting machine, and the shaft and cylinder of the index assembly are the only other machine-shop parts.

The faceted gems in the picture include precious topaz, citrine, green and pink tourmaline, smoky quartz, kunzite, amethyst, aquamarine, golden beryl, and various colored quartz.

SUNDIALS AND THEIR CONSTRUCTION

Part VII—Lines of Declination on Different Types of Dials

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory

THE lines of declination on the equatorial dial are circles; but on other dials, such as those whose planes lie oblique or parallel to the axis of the earth, they take the form of ellipses, hyperbolas, and parabolas. One does not have to understand the theory of conic sections in order to construct these lines, because they may be easily laid out by the same method (graphic) used for the hour lines.

The construction of the lines of declination for the south vertical dial is typical of those dials whose planes lie oblique to the axis of the earth. It will not, therefore, be necessary to describe the construction for each dial of this type, for the description of one may be applied to all. As a guide to the reader, additional diagrams have been included showing the location of the lines on various dials.

THE following example shows the construction of the lines of declination for a south vertical dial in 50° north latitude.

Figure 1 shows the dial completed. The line *C′* 12 is the substyle line; the foot of the perpendicular style is marked at *F′*. On this dial the horizontal line will pass through the foot of the perpendicular style, at right angles to the substyle line.

On any dial whose plane lies oblique to the axis of the earth the equinoctial line will be a straight line, and perpendicular to the substyle line. To find the position of the equinoctial and other lines of declination, another diagram is brought into use, such as that shown in Figure 2. Early diallists called this figure a trigon, and by it many problems of the sphere were solved.

In Figure 2, the horizontal line *PC* represents the style; *CF* the substyle; *P* the nodus; *PF* and *F*, the height and foot of the perpendicular style, respectively.

At the point *P*, draw *PE* perpendicular to *PC*. This line represents the equinoctial.

Draw *PN* and *PS* for the greatest northern and southern declination of the sun. Angles *NPE* and *EPS* will be equal to 23°27′.

Now, produce *CF*, cutting *PS* at *b*, *PE* at *a*, and *PN* at *o*.

In Figure 1, *C′* corresponds to the point *C* of Figure 2. Lay off the distance *Ca*, from *C′* to *a′*, on the substyle line *C′* 12. The equinoctial line will pass through the point *a′*, perpendicular to the substyle, and parallel to *K″C′K′*.

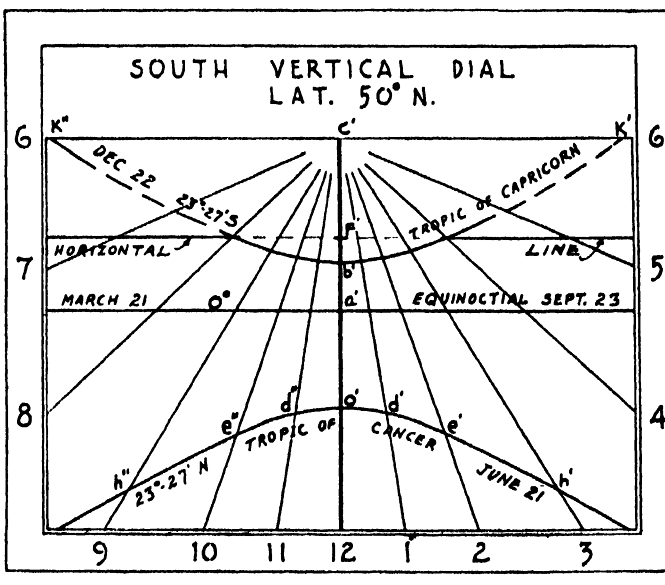


Figure 1: **The south vertical dial—lines of declination**

With *C* (Figure 2) as a center, describe arcs cutting the line *PE*, whose radii are equal to the distances from *C′* (Figure 1) to the points where the equinoctial line cuts the various hour lines. Through the points thus found on *PE*, draw lines from *C* cutting *PS* and terminating in *PN* at *o*, *d*, *e*, and so on. These lines represent the hour lines on the dial plate (*Co*=12; *Cd*=1 and 11; *Ce*=2 and 10; and so on).

If the distances *Co*, *Cd*, *Ce*, and so on (Figure 2) are plotted on the corresponding hour lines (Figure 1) from *C′* to *o′*, *d′*, *e′*, and so on, and to *d″*, *e″*, and so on, a curved line drawn through those points will represent the path of the shadow of the nodus when the sun has a north declination of 23°27′.

Similarly, the line *K″b′K′* (Figure 1), representing the path of the shadow of the nodus when the sun has a south declination of 23°27′, may also be plotted by taking off the distances from *C* (Figure 2) to the various points where the lines *Co*, *Cd*, *Ce*, and so on cross the line *PS*.

A line drawn from *C* (Figure 2) perpendicular to *PC* and cutting the line *PS* at *K*, will give the location of the point where that line of declination intersects the 6 o'clock line, as at *K′* and *K″* (Figure 1). It is not necessary to extend this line beyond the horizontal line.

All other lines of declination will fall between the lines *K″b′K′* and *h″o′h′* (Figure 1); and they may be plotted as shown above, by inserting the desired lines in Figure 2, making angles with *PE* equal to the declination, on either side of that line, as the declination is north or south.

THE position of the lines of declination on an horizontal dial in 40° north latitude is shown in Figure 3. It is evident that the horizontal line cannot be placed on this dial, because the plane of the dial lies parallel to the plane of the horizon.

Note that the Tropic of Cancer, which is the line nearest the center of the horizontal dial, is farthest from the center of the south vertical dial (Figure 1). It will be easier to visualize the position of these lines if they are labelled north or south declination, and the direction of the celestial pole properly indicated, as shown in Figure 2.

FOR the lines of declination on the direct north and south reclining dials the work is done in exactly the same way as that for the south vertical dial. The height of the style is its elevation above the dial plate (Explained

on page 251 of the May, 1934, number).

The location of the horizontal line on these dials is derived in the same manner as for the equatorial dial, described in the September number, and it is perpendicular to the substyle line.

THE position of the lines of declination on a south vertical dial, declining 20° east in 40° north latitude, is shown in Figure 4. In this dial *AF* is the substyle line (not the 12 o'clock line); *AN* is the style; angle *NAF* is the height of the style; *N* is the nodus; *NF* and *F* the height and foot of the perpendicular style, respectively.

In order to construct the lines of declination on this dial, first, with the substyle *AF* as the meridian or 12 o'clock line, lay out the hour lines for an horizontal dial, the height of whose style is equal to the angle *NAF*.

Then, with all the parts of the gnomon for the horizontal dial equal to those of the declining dial, proceed to lay out the lines of declination, as previously described. Thus will the lines for the declining dial be properly constructed.

The horizontal line, on declining dials, will pass through the point where the equinoctial line intersects the 6 o'clock line, as at *K*. From *K* it is drawn through the foot of the perpendicular style, at *F*; and at right angles to the meridian line of 12 (in the figure, *AB* 12).

DURING the short period that the sun shines upon the north vertical dial, it has but a small elevation above the horizon. For this reason, the lines of declination are seldom drawn upon this dial. The lines may be constructed if the work is done in the same manner as for the south vertical dial.

The construction of the lines of declination for the east and west reclining dials is the same as that for the declining dials, where an horizontal dial is described about the substyle line on the reclining dial. The height of the style for the reclining dial is used as the height of the style for the horizontal dial. Then, the lines of declination constructed for the horizontal dial will be the lines for the reclining dial, as shown in Figure 5. The diagram shows the appearance of the lines on a direct east dial, reclining 25° in 37° north latitude. The line *SF* is the substyle; *F* the foot of the perpendicular style; and *N* the nodus.

The horizontal line, *AB*, is drawn through the point where the equinoctial line cuts the 6 o'clock line, and parallel to the 12 o'clock line, which on this dial is parallel to the plane of the horizon.

●

The next installment will describe the construction of the lines of declination for dials whose planes lie parallel to the earth's axis, and another simple method of plotting them.

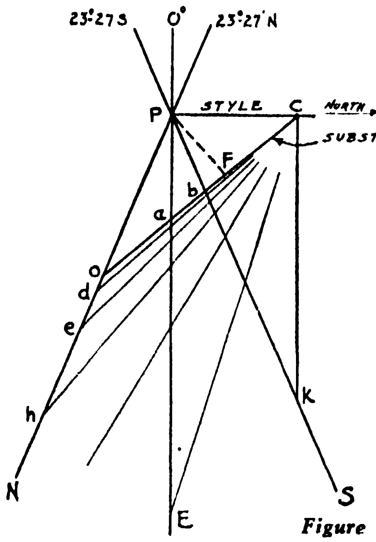


Figure 2

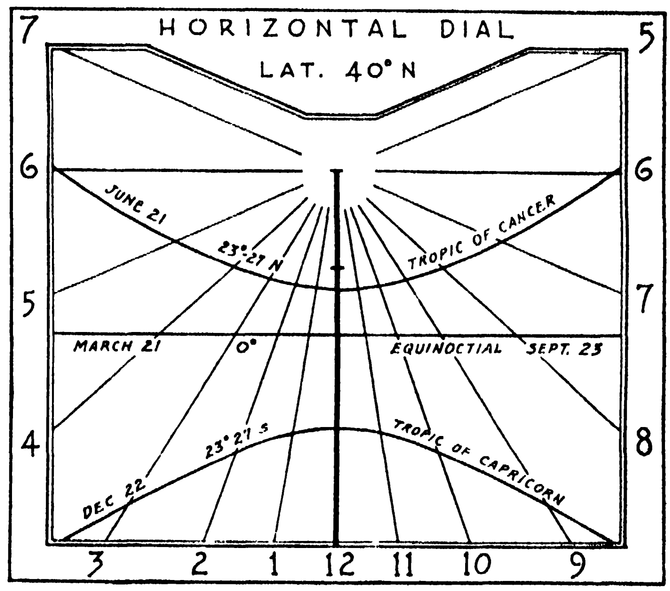


Figure 3: **Lines of declination—horizontal dial**

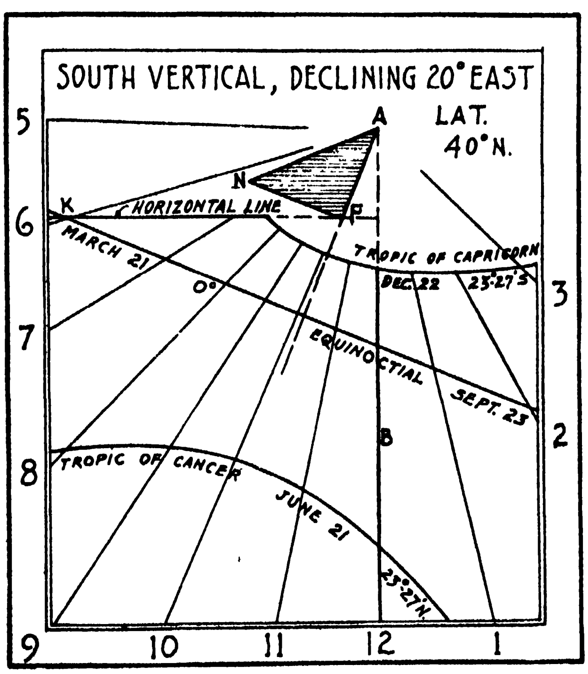


Figure 4: **South vertical, declining 20 degrees east**

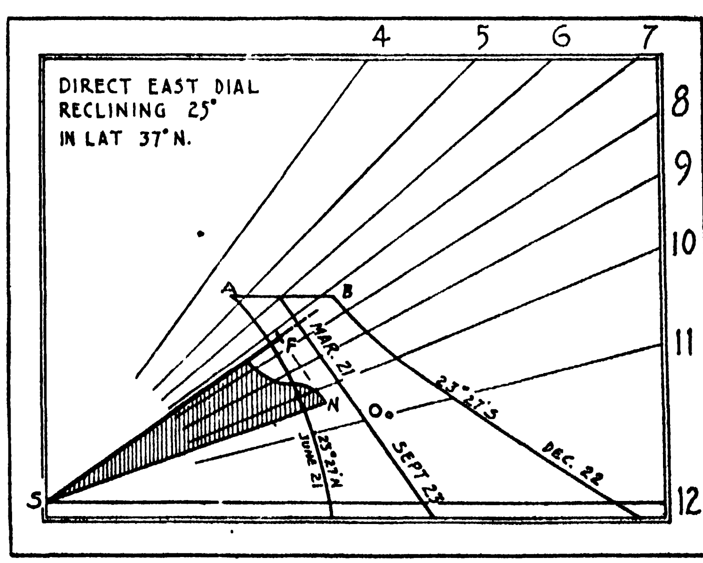
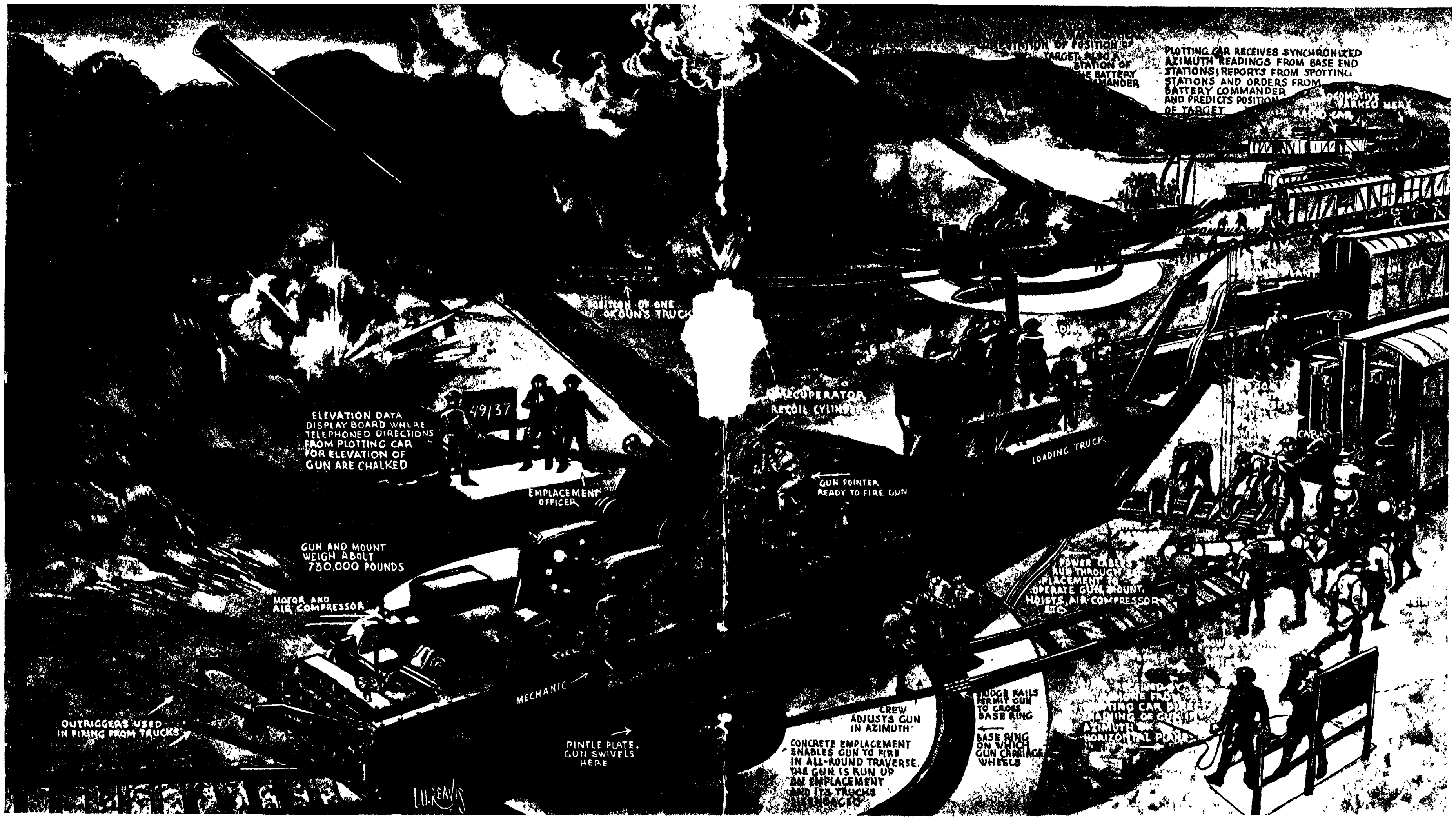


Figure 5: **Direct east dial reclining 25 degrees**



FOR DEFENSE OF THE PANAMA CANAL

A DIRECT hit at a distance of 23½ miles on the forward turret of a target simulating the battleship *California*—that is the record made by one of the two guns, shown here in a hypothetical situation, which have been constructed for defense of what is perhaps our most vulnerable shipping lane, the Panama Canal. These two 14-inch guns, the largest of their type except for two others rumored to be on our west coast, represent the peak of development in extraordinary artillery armament devoted expressly to defensive purposes. In ingenuity of construction, mobility, and ease of operation, these guns add spectacular interest to long range measures for land resistance to naval attacks.

At strategic and concealed positions at each end of the canal, emplacements, with necessary turn-tables and side-tracks, have been constructed for these guns. While they are shown here relatively close together, actual emplacements are sufficiently distant from each other to make it impossible for one naval shell to disable both simultaneously. The guns, together with necessary ammunition, tool, and machine shop cars are moved on railway tracks at train speed from one end of the canal to the other as needed. From two to three hours are required to move a gun from traveling position to firing position and about five hours are required before firing can be begun.

With radio-equipped airplanes as spotters of enemy fleet movements, with highly developed mathematical instruments for sighting and control, with carefully plotted artillery maps of waters within range, and with freedom to move in a complete circle this defense scheme would prove a formidable obstacle for hostile ships to overcome.

Drawing prepared for SCIENTIFIC AMERICAN from data kindly supplied by James T. Campbell, C. A. C., Fortress Monroe, a former commander of this battery, and through the courtesy of the office of the Chief of Coast Artillery.

DOES YOUR SLEEPING ROOM

By DONALD A. LAIRD, Ph.D., Sci.D., F.R.S.A.
Director, Colgate University Psychological Laboratory
Hamilton, New York

ONE thing about the American home makes me snort. It is this: Why are the sleeping rooms invariably bright, cheery and contrived, seemingly, for almost every purpose except sound sleep?

This abruptly posed query may come, gentle reader and home lover, as something of a shock. It may make *you* snort. For at first thought, one may think that nothing could be more desirable than a bright, cheery and pleasant sleeping room. Yet the truth is that nothing is more important than sound sleep, and sound sleep cannot, as a general thing, be had in the bright and cheery rooms so much in vogue among present-day home builders, no matter how much relaxation your bed cushion encourages. On the contrary, if you would sleep well in the new home of your dreams, on which you have spent so much time and thought and good hard dollars —indeed, if you would keep good health and spirits with which to enjoy your home long and well—make the sleeping rooms like the bear's cave—blue and green with shadows, sheltered from outer noise as with woodland leaves and wild boscage, and completely free from vagrant air currents which cause even the gentlest motion of, and therefore sound from, curtains, calendars, lamp shades and other ornaments, as well as from polished metals and glasses which reflect semi-rousing gleams and beams in human bed chambers.

OFF and on, at the Colgate Psychological Laboratory, we have been studying sleep for some ten years. Not only have we obtained definite data on sleep habits from hundreds of persons in all walks of life, but we have had scores of students sleeping under the eyes of scientific observers, on beds especially constructed, hung on springs and equipped with any number of gadgets for measuring and recording the slightest movements, changes in respiration and bodily condition of the sleepers. We have thus watched the effect of light and light beams, of noises gentle and heavy, of short sheets and heavy blankets—indeed, of everything we could think of—on human sleepers. Not only the immediate effect, of course, but the after effect. In other words, the resultant measure of energy and good spirits possessed by the sleepers the next day after sleeping under varying conditions; and, as well, the gain or loss in these desirable things as a result of long periods of sleeping in ideal or non-ideal conditions. That is to say, for brevity's sake, bear-cave rooms or the bright, cheery rooms.

We found that humans sleep soundest and with best results in absolutely dark, silent, still places, and that those who get such sound sleep are vastly happier, more energetic and efficient than those who do not. Indeed, we are convinced that many a man and woman who is ailing around and worrying because he or she cannot sleep—or even doctoring for insomnia, or taking one or another of the countless sleep potions to be had at the druggist's—is really suffering from nothing more serious than the continued attempt to sleep in bright, cheery, pleasant rooms more adapted to wakeful living than to sleeping, or on a cushion that tortures instead of relaxes; and that countless folk who think they do not get enough sleep, or do not get enough hours of sleep, do get in enough sleeping time, and would get enough sleep if in that time they slept under conditions where deep sound sleep were possible. We humans spend, roughly speaking, one third of our lives in sleep, and the Colgate research proves, if proof were needed, that how well we improve and enjoy the other two thirds depends to a truly great extent upon how soundly we sleep. Should we not then plan our sleeping room with as much of an eye on good sleep as we do our kitchens with an eye to the speedy preparation of good food? Or the living room with an eye to comfort and hospitality?

A bed in the sleep laboratory in the author's home. Thermograph at left records the temperatures. Dial of kinetometer to which Dr. Laird is pointing shows the total vertical displacement of top of mattress during the night. Special clock records all turning over in bed

AFTER all, the business of building a sound sleeping room is simple enough, and for the home builder, who has to buy new furnishings anyway, it should cost very little more than any ordinary home "sleeper."

Let us consider first the problem of making a room quiet. Providing vacuum walls with air-tight doors and windows would do the trick, but not for humans. However, that's the ideal, and the puzzle is to approach it as nearly as possible while assuring ventilation and ordinary ease and comfort of living. Sometimes, it is puzzling indeed.

Well, then, how can a sleeping room be made sufficiently noiseless? Naturally, the degree of defense against outside noise must depend upon the location of the room and the amount of noise, and the measures which would suffice in one location might not suffice in another. But let us consider a room such as a friend of mine set up, which was in the end about as quiet as a human sleeping room could be made. First, he lined the ceiling and the upper walls with a thick, blotter-like sound-proofing material which actually absorbs as much as 75 percent of the sound that strikes it. He covered the floor with thick-pile carpets and rugs, hung the windows with heavily shirred velour curtains and put a

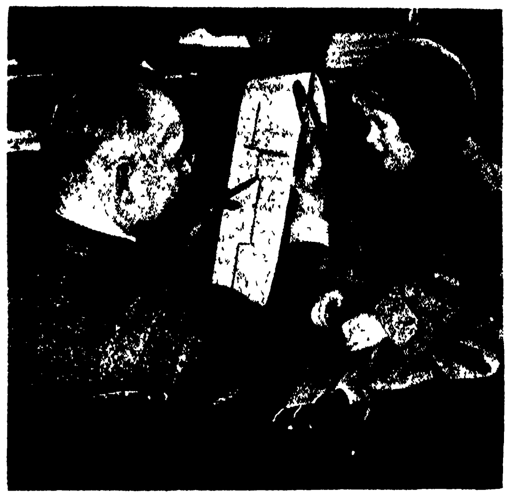
Give You Insomnia?

velour spread upon the bed. All of these materials absorb noise as a sponge absorbs water. He fitted the doors with spring-bronze weather stripping, and put silencers—acoustical baffles which block noise but permit ventilation—at the windows. Not content with these, however, he put velour-covered screens before his windows—and when he had done you couldn't hear in his room the radio or the voices in the other parts of the house.

While my friend's home, by reason of its location, was not subjected to the other main aspect of this form of sleep insurance—unwanted light—I have talked with any number of home owners who find it a major difficulty; especially those whose houses are close to the roads or streets where beams from street lamps, passing automobiles or sometimes the glare of downtown sections of cities invade the room through the windows. When you are dog tired from heavy manual labor or a long period of enforced wakefulness you might possibly be able to sleep deeply with your room fully lighted. But this is not often the case, especially for people engaged in what we call, for want of a better term, brain work. By and large, it may be said that light invariably makes sleep lighter and less refreshing—if, in truth, it doesn't rout it altogether. For a nervous person, or one prone to worry, to attempt to sleep soundly in a room where light penetrates, even in a slight degree or only occasionally, is very difficult and often impossible.

IMMEDIATELY, of course, you think of curtains. Surely, they keep out the light. They do, to an extent, of course, if they are black, dark green or blue, and perfectly opaque, and if their edges travel up and down in grooves at least an inch deep. Ergo, if you want to sleep well, have that type of curtain in your room—rather than the light-colored, translucent ones so often found in "bright, cheery rooms." Yet, even with such curtains, light will come in at the bottom or top, which-ever you choose to leave open for ventilation. Coming in, if such vagrant light finds a nice bright-colored interior, it has a fine and, from the sleeper's viewpoint, a devilish time. It actually expands and multiplies itself when reflected from the white or light-colored walls and curtains and furniture. Then, assuming that it strikes a silver, gilt, or polished metal fixture or toilette array, it concentrates itself and plays in a bright beam through the darkness. Shut your eyes, sometimes, and let a light beam play over them, then you'll have some conception of what a force for poor sleep a light beam is.

Given dark, opaque curtains, what next? Well, in a room perfectly protected against light, the walls must be of some dark, restful color, preferably following the tints of the deeps of



shadow, the night sea or sky. Deep blues or greens are best by all odds, though black lightly lined with silver is smart and not bad, scientifically. All points, woodwork or wall paper must be of the dull or frosted type, rather than the glossy, gleaming kind which, even though black, reflect light like a mirror. So, too, must be the case with such ornaments and fixtures as may be necessary. Coverings for mirrors and telephones are, of course, highly satisfactory as defenders from light. Screens before the windows—dark-colored, opaque screens—are essential, too, even where one has the silencers mentioned above at the windows, because light has a fierce penetrative power. If you don't believe it, observe sometime how the rays of automobile lamps will stream through the chinks of a blind or around an ordinary curtain as, say, the car turns before your window and the light sweeps past it.

Not only will such a room keep out or eliminate those twin enemies of sleep—noise and light—but it has a further and tremendous psychological advantage. Suppose now that the general idea of this perfected sleeping room is carried out in other details. The lights are

Above: The sleep laboratory, on the floor below the bedroom, is itself walled with absorbing material (a patch shows behind author) and its windows are double—its walls filled with powdered gypsum. Note somno-kinetograph, sleep movement recorder. _Left:_ Sleep record

well shaded and soft when turned on; the paintings, portraits or pictures are all of a restful, subdued nature, both in subject and treatment; there are no touches of red, yellow or orange in the many minor things that one must have in sleeping rooms. You enter. You are in a place that literally breathes restful influence, the idea of peace, rest and security. The deep silence itself woos you to slumber, and the restful greens and blues lull you to sleep on the bed cushion with a psychological spell that is, all things being equal, verily overwhelming and in the long run irresistible. You may have come from a highly stimulating and exciting social affair, bridge tournament, a dance or even a business meeting where you have battled to the limit of your resources, but you will find in such a room as we have described a veritable sleep-producing charm. On the other hand, after such stimulation, enter the usual bright, cheery, noisy room, with its light colors—often its red, yellow or orange colors—and you will, in many instances, be playing the bridge games, or fighting the business battles, all through the night; and in the morning be convinced that you have a bad case of insomnia.

I SLEPT in ordinary, bright, cheery rooms for years. Then, awhile back, I built myself a room of the type outlined in this article—and I wouldn't give it up for a fortune; that is, unless I could get another like it. It has paid for itself many, many times over, in dividends of better health, better spirits, and consequently better work.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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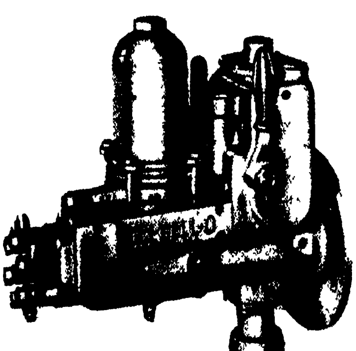
Diesel Fuel Injection Pump

THE long anticipated "made in America" standard fuel injection pump for builders of high-speed Diesel engines, which will challenge what virtually amounts to a foreign monopoly, has been announced by the Ex-Cell-O Aircraft and Tool Corporation. Most engines manufactured heretofore in the United States have used foreign built fuel injection pumps. This significant announcement was made recently by Mr. C. R. Alden, Research Engineer of the corporation.

European countries have been far ahead of the United States in utilizing Diesel



Injection pump for Diesel engines

engines for commercial transportation, perfection having been achieved to such a degree that all trucks of two-ton capacity or over exhibited at the European shows this year were equipped with Diesel power.

The American company has been developing its fuel injection pump for the past seven years and announces it now only after extensive field tests by some of the large engine builders. These tests, it is claimed, have proved the pump completely successful on every count.

One of the difficult problems in the perfection of light, high-speed Diesel engines suitable for motor truck use has been the extreme precision necessary in the manufacture of fuel injection equipment. It must be capable of metering a quantity of fuel as small as 14 millionths of a pound, compressing it, and injecting it in the form of a highly atomized spray into the engine cylinder in a time as short as one two-thousandths of a second.

The pump consists of two major parts: the drive unit and the hydraulic unit. The drive unit is mounted directly on the engine, making it practically a part of the engine structure. This enables the engine builder to eliminate several parts and operations and will not permit misalignment which causes rapid wear.

The hydraulic unit is removable and is furnished as a sealed assembly. This requires a minimum amount of time for servicing, all of the precision or hydraulic parts of the pump being replaced as a unit.

Incorporated as an integral part located on top of the fuel injection pump is a secondary filtering unit. The fuel oil must pass through this filter before entering the hydraulic unit. Foreign material is thus removed that might otherwise damage the system. A two-step filter is employed, the first being a specially woven wool fabric and the next a spirally wound edge filter.

A fuel transfer pump is available for delivering oil to the injection pump if there is not sufficient gravity head.

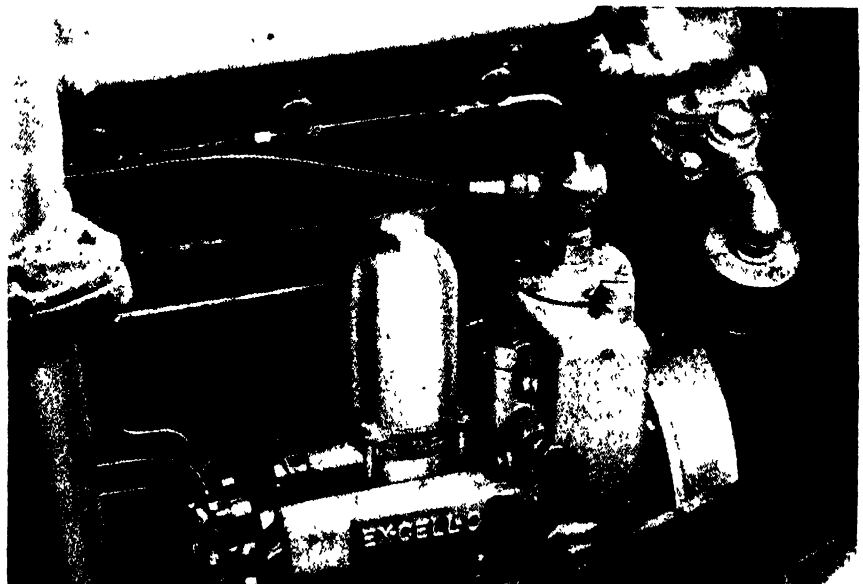
The new fuel pump may be furnished with a governor in which can be incorporated features adapting it to automotive, marine, industrial or constant speed service.

Ceralumin, a New Light Alloy

A NEW light-weight alloy of high strength has been developed by the use of the relatively rare metal cerium, from which the new alloy derives its name, Ceralumin. The composition of the alloy is copper 2.5, nickel 1.5, magnesium 0.8, iron 1.2, silicon 1.2, cerium 0.15 percent, the remainder being aluminum.

Investigations have established the fact that cerium allows the beneficial mechanical effects of a high iron content to be obtained by suppressing the embrittling iron-aluminum constituent which is otherwise liable to be formed. In addition the small amount of cerium also confers on the alloy important advantages in the foundry; Ceralumin has extremely good "running" properties and gives castings having a smooth clean surface and an attractive appearance.

In the heat-treated condition Ceralumin



The new Diesel engine fuel injection pump installed

presents an excellent combination of high tensile strength at ordinary and elevated temperatures, high elastic limit and high Brinell hardness as well as a very high fatigue strength, a quality which should prove of special interest to designers anxious to take the fullest advantage of the properties of available materials. The alloy is suitable for high-duty service in the form of die-castings, chill castings and sand castings, and it is anticipated that it will find a useful field of application in the aeronautical and automobile industries.—*A. E. B.*

Amateur Photomicrography

AN addition to the equipment of the amateur microscopist has recently appeared in the form of an inexpensive photomicrographic outfit for photographing specimens in the field of the microscope. The price of

Taking a photomicrograph

12 dollars is a long jump from the hundred-dollar tag which has dismayed many amateurs who have looked at the professional outfits. This does not imply that professional work cannot be done with this compact little outfit. It is in no sense a toy and the results obtainable with it are limited only to the quality of the microscope and the skill of the operator.

The outfit can be used with any good amateur or professional microscope and the procedure is very simple. The microscope is placed on the base of the stand and held by a forked metal clamp. The camera is adjustable up or down on a vertical rod and can be swung to the left or right. It uses standard 127 roll or cut film in holders. Cut film of flat celluloid is generally used by professionals because results may be checked more easily after each exposure. A good source of illumination is a 100-watt frosted bulb in an ordinary gooseneck desk lamp.

Attached to the side of the camera is a focusing tube with which the object may be seen on a focusing disk. When the exact focus is secured the camera is swung over the microscope ready for the exposure. A light-tight connector fits over the eyepiece of the microscope and into the shutter opening of the camera to keep stray light from reaching the film.

A New Jack-Driven Tunnel Shield

THE accompanying drawing serves to clarify the application and economy of using the T & M Tunnel Shield, now built by Link-Belt Company at Philadelphia, for constructing tunnels underground without disturbing the surface.

This shield is a combination jack-driven shield and block placer which can readily be guided to line and grade and can place 25 feet of precast block lining per eight-hour shift, provided soil conditions are such that the remaining operations can be co-ordinated to meet this pace.

The machine itself requires two men—a trained operator and a block placer. The jacks extrude the completed lining into the earth bore and cause the shield simultaneously to advance and dress the mined hole.

All remaining functions—mining, spoil removal and disposal, and delivery of blocks to the shield—are subject to any modus operandi the experience of the contractor may dictate. As a rule, the expedition with which the contractor prosecutes this part of the job will determine the daily progress of the tunneling machine.

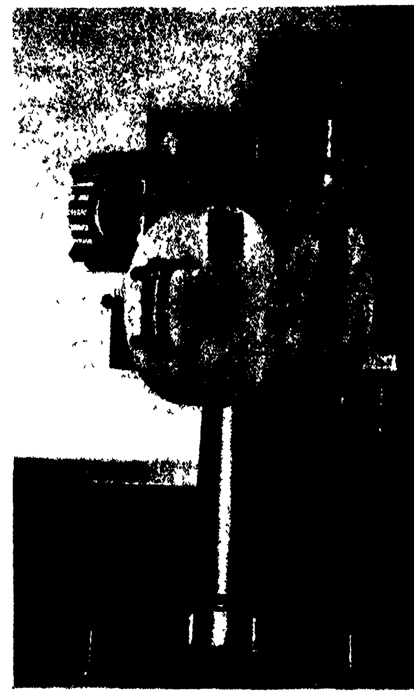
Sound Movies By Television

A FORERUNNER of what may be tomorrow's home entertainment was demonstrated in the laboratories of the Peck Television Corporation in New York, when scenes from current newsreels flashed across a television screen. William Hoyt Peck, president and chief engineer of the company, has devised a new type of film scanner, built entirely without gears and using two automobile headlight bulbs as its only sources of light to actuate the photo-electric cells for both the sight and sound channels.

To pick up the picture, a concentrated beam is projected onto the face of a revolving mirror lens disk, which causes it to scan the film horizontally. Vertical scanning is accomplished by the continuous motion of the film at the rate of twenty-four frames per second.

The receiver likewise makes use of a headlight bulb as its light source, and of reflecting lenses in its scanner. These lenses are each made from a single glass casting, silvered on the back, and are said by the inventor to be as efficient and as highly corrected as a photographic triplet.

Sixty-line images were seen during the demonstration, but although a great amount

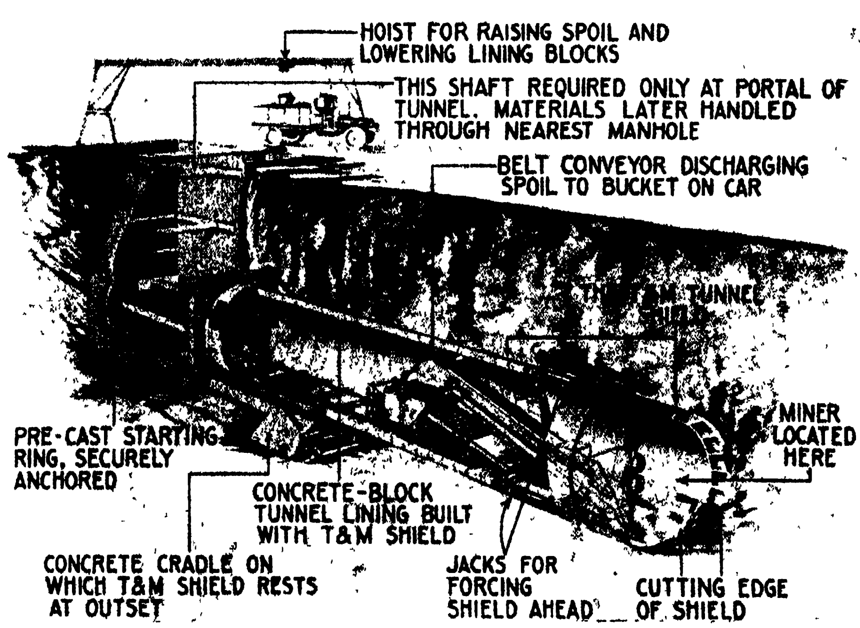


Television pick-up for movie film

of detail is not expected in pictures using this number of lines, observers were able to see the swing of baseball bats even in long shots of the diamond, the motion of hockey sticks as players skimmed over the field of ice, to read the numbers on racing horses, and to recognize Samuel Insull, Premier Mussolini, and Eddie Cantor, close-ups of whom were shown.

"The unusual brilliance of the image," said Mr. Peck, "is explained by the fact that all of the light from the source is concentrated to a point, all of which strikes each lens in turn, as the scanner rotates. When lenses are arranged in spiral form, as is necessary on the ordinary disk, the spot of light must be large enough to cover both lens #1 and lens #60. This means that three-quarters of the light is being wasted at all times."

In Peck's receiver, the light source is on the same side of the disk as is the screen



How the new jack-driven tunnel shield is put to work

upon which the image is projected. He claims that allowing for all losses from reflection and refraction, 83.33 percent of the available light is used. Pinhole disks, he says, make use of only 1/4320th of the light.

The light is modulated by means of a modified Kerr cell, which measures less than one cubic inch over all, contains but fifteen drops of fluid, and has an internal capacity of only 0.000006 mfd. A pair of screen grid tubes are used to actuate this cell, as an output of only 1/20 of a watt is required for its operation.

Salt Bottom on Salt Lake

SALT in the amount of 400,000,000 tons is the estimate of the lake bottom lining of Salt Lake in Utah. At least this is the estimate of three scientists who have made a study of the lake. Beautiful crystals of salt are said to form a lining two inches thick.

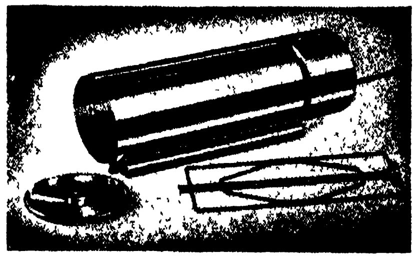
Rubber Cement Improves Bronze Castings

RECENTLY two large bronze plaques, to be used at the entrance to the grounds of the National Bureau of Standards, Washington, D. C., were cast in the experimental foundry of the bureau. These plaques carry the Department of Commerce seal and the inscription, National Bureau of Standards, in raised letters on a matte background.

With regular foundry technique the results were not entirely satisfactory because of a slight washing of the sand and other causes, says *Industrial and Engineering Chemistry*. C. M. Saeger, Jr., chief of the foundry section, overcame the difficulty by spraying the mold surfaces with rubber cement. By this means, firm adhesion of the fine surface particles was secured and accurate reproduction of the details of the plaque face was assured. According to Mr. Saeger, economy in handling of molds, as well as in producing castings of a very excellent quality, is obtained by the use of rubber cement surfacing.—*A. E. B.*

Electric Cream Freezer for Automatic Refrigerator

A NEW electric motor-driven ice cream freezer which fits into the freezing or ice-cube compartment of an automatic refrigerator has just been announced. It enables the housewife to make with simple ingredients—only milk and cream, sugar and flavoring—smooth, firm, velvety ice cream free from objectionable icy crystals.



***Right:* The parts of the new ice-cream freezer. Motor is in end of tube. *Above:* Placing the freezer in the automatic home refrigerator**

Ever since the introduction of the automatic refrigerator there has been a demand in the homes for such an idea, and various manufacturers have spent a great deal of time and money endeavoring to perfect such a device. The new freezer is almost absurdly simple. It consists of a cylinder with a motor at one end, equipped with a beater, and fastened to a flat base. The cover to the cylinder is held in place by a spring latch.

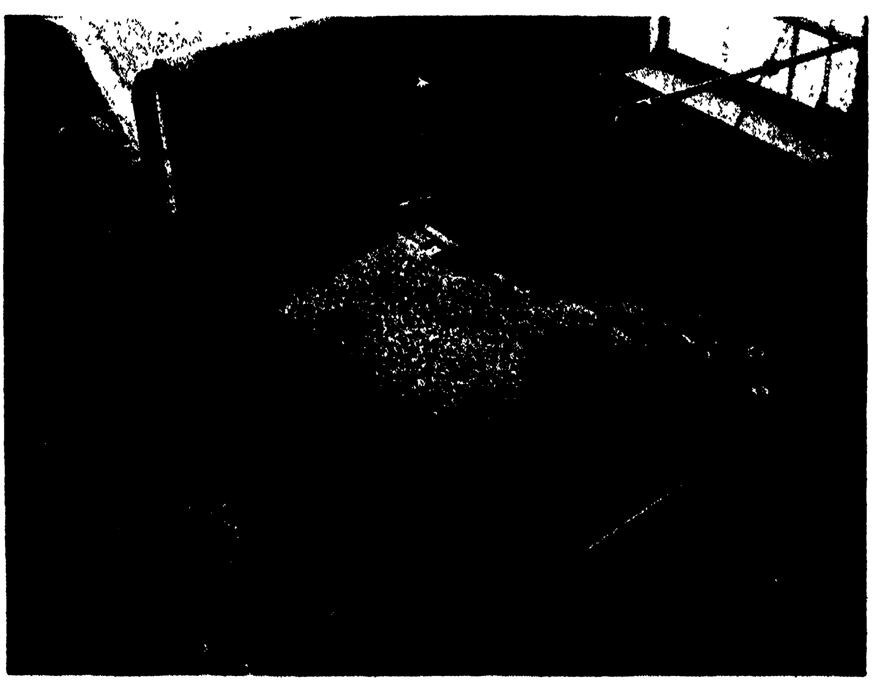
The use of the freezer is extremely simple too. All the housewife has to do in order to prepare any frozen dessert is to pour in the ingredients, fasten the cover with the spring latch, attach the cord to any convenient outlet, and place the freezer in the cube compartment. The motor of the freezer automatically stops when the ice cream or dessert is frozen to the proper firmness.

After the freezer is shut off, the ice cream is sufficiently solid to serve, but if further hardening is desired, the dessert may be left in the freezer or emptied into the trays of the cube compartment.

The new freezer holds three pints, is made of non-staining, highly polished alloy and is very easy to keep clean.

An ingenious feature of the design is the method of getting the electric current supply to the motor of the freezer. The cord is very thin and flexible, and its construction, coupled with the flexibility of the refrigerator door gasket, enables the door to be closed on the cord in such a manner as to keep the refrigerator door tight and at the same time not damage the cord even after long continued use.

Making frozen desserts isn't the only thing that the freezer will do, for it will chill and mix drinks without ice dilution, beat eggs, whip cream and mix batters.



Until recently, scrap leather has been almost useless to industry. Formerly it was used to make prussiate of potash, a process which became obsolete. Then the scrap material was disposed of by burning. Now, however, by the use of the machine illustrated above, continuous sheets of genuine leather board are produced from leather fibers obtained from scraps. Because of the tough and tangled nature of the fibers, it is possible to make a synthetic "hide" that rivals the original form of the leather in both strength and industrial usefulness.—*A. E. B.*

Latex-Lined Fur Coats

IT is reported in *Rubber Age* that latex, the milky sap of the rubber tree, is being used in connection with an inner lining for fur coats. The latex is applied to the skin and the silk lining placed over it. The claim is made that this process not only increases the warmth of the coat but also strengthens the seams where the skins are sewed together.—*A. E. B.*

The Future of the Air Mails

WE have never, in these columns, taken sides in the controversy which followed the annulment of all domestic airmail contracts as of midnight, February 19, 1934. Since then things have more or less settled down. After the disastrous carriage of the mails by the Army, the calling for new bids, and much heated argument, the situation remains substantially as before. The same operating companies are carrying the mail over the same routes, except that the rates are much lower and the companies are losing money. Strange to say, one of the lines

John H. Geisse, who is doing much to promote safety in private flying

is now actually giving passenger service which is some 50 percent faster than the airmail service.

We will leave it to others to determine whether the governmental action has improved the situation or not. It is more refreshing to consider what the future will hold. A book by Paul T. David entitled "The Economics of Air Mail," published under the auspices of The Brookings Institute, sets forth a few guiding principles in its last chapter, and these may be of interest to summarize.

Companies should disassociate themselves from each other in the interests of full and free competition in bidding. This is a splendid theoretical concept; the only difficulty is that over any given line, there are not and never will be, in all likelihood, two competing systems.

Next, Mr. David thinks that the operating companies should be disassociated from the manufacturing companies. This has already been done and seems to be a wise measure. If operating companies purchase in the open market, competition is certain to bring forth greater design efficiency.

Contracts should be awarded, Mr. David thinks, for not longer than a year, owing to the uncertainty of growth on long-term contracts. This again is theoretically reasonable. What it will mean in practice is that the companies will never make a profit on their airmail operations. Whether it is desirable that companies should never make a profit on airmail is not for us to say.

Another point which the author brings up is that new legislation should protect the post-office department against pressure for unjustified extensions of service, this to be done by a statutory requirement that services be withdrawn when the average mail load drops below some stated minimum for three successive months.

For a more permanent program Mr. David advocates a reform in accounting methods, compensation in full for the cost of mail transportation, passenger subsidy contributions on a definite basis, and so on.

In the opinion of this writer and of many authorities, the best way to handle the airmail situation is to place it under the Interstate Commerce Commission, with power to regulate rates, and so on, in much the same manner that this Commission now regulates the railroads.

An unfortunate situation might then arise: the Air Commerce Bureau of the Department of Commerce and the Interstate Commerce Commission would both then have a hand in regulation. Perhaps the Commerce Department would restrict itself to private, non-scheduled flying, and the Interstate Commerce Commission to control of the regular air lines.—*A. K.*

Airplane Safety

THERE has been created by Congressional amendment a Development Section in the Bureau of Air Commerce, Department of Commerce. Prior to the creation of this new Section, the Department was authorized to develop only air navigation aids, such as radio and lighting facilities. Now it has authority to carry on the development of airplanes, airplane engines, and accessories. The Assistant Director in charge of this new work is John H. Geisse, an aeronautical engineer of splendid technical training and experience, a former Army pilot, with several important executive positions in aeronautics to his credit. The first main objective of the Development Section is increased safety in private flying, and we are indebted to Mr. Geisse for an interesting and comprehensive statement on the subject, the substance of which is given below.

Safety for private airplanes has lagged behind other aeronautical developments, and it is this lag which is largely responsible for the lack of interest in private flying. The industry is not to be blamed for its failure to produce more suitable equipment for the private flier. In all lines of business, development is ordinarily paid for out of earnings, and the manufacturers of private airplanes simply have not had the earnings necessary to finance the development of new types.

Another retarding factor has been the expressed opinion of a large group in the aviation industry that airplanes having any safer flying characteristics than those presently available are neither needed nor desired. Another contention of this group is that fliers who have been trained on safe airplanes are almost sure to fly other types of aircraft with disastrous consequences. Still another opinion frequently voiced is that it is impossible to train a pilot on an airplane which flies itself.

Mr. Geisse disagrees with these views, and states definitely that until it is possible to make training for flight a minor item, sales of airplanes for private use will be limited.

Henry Ford once stated that flying was now 90 percent pilot and 10 percent airplane and that until these figures were reversed it could have but a limited scope. This view is reinforced by the fact that over 50 percent of accidents in private flying are charged to errors on the part of the pilot.

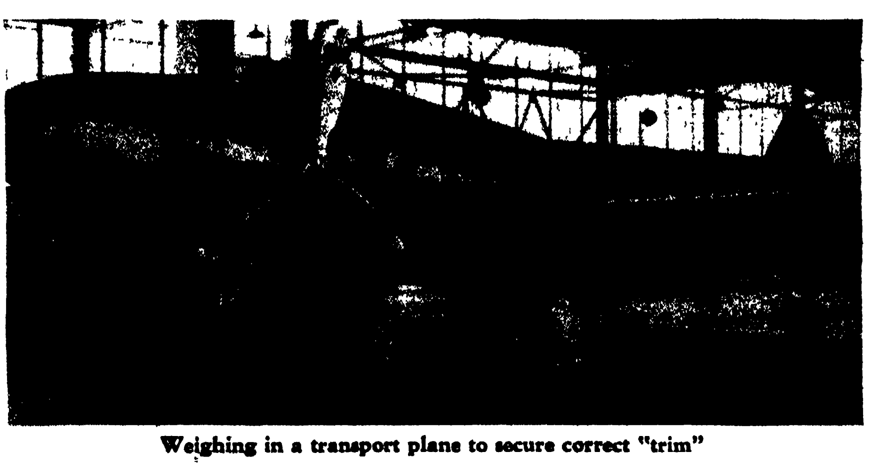
The Air Commerce Bureau believes that it is now possible to produce airplanes which will bring flying much more closely to 90 percent airplane and 10 percent pilot. A first step in its safety program has already been taken by calling for bids on the production of 25 airplanes for the use of the Department of Commerce, to meet specifications which demand unusually safe and easy operation. The Bureau is in hopes that this competition will bring forth an airplane which can be handled successfully by a pilot trained in a fraction of the time now required to learn how to master the more conventional types. At the same time the Bureau has kept in mind a drastic reduction in the cost of flying, which will follow naturally on greater safety and the consequent increase in sales volume.

This program is, of course, a subsidy to aviation. The justification of the expenditure of federal funds on the development of aviation, not only as a means of furthering national defense but also of fostering a new industry, hardly needs comment. This type of subsidy, consisting in the purchase of new equipment is, moreover, not self-perpetuating, and is therefore economically sound.

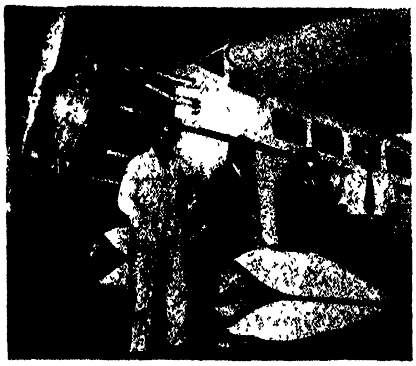
Ensuing steps will depend on the outcome of the competition. At any rate an excellent beginning has been made.—*A. K.*

Weighing In

A MOST important item in the operation of airplanes lies in securing correct weight and trim. This process is in some respects analogous to the trimming of cargo on board an ocean vessel and in careful hands the airplane is weighed up and its center of gravity is located prior to every trip. One of our photographs shows a Boeing transport plane undergoing this checkup. It is, of course, necessary to use three scales to get the center of gravity. Special types of scales have been devised by Fairbanks, Morse and Company. Although these register weights up to 16,000 pounds, they are easily handled by one man. The point in the design of the scales is that they are only 2¼ inches above the floor, so that no ramps are required. With these instruments the weighing in process has been reduced to one fourth of the previous time.—*A. K.*



Weighing in a transport plane to secure correct "trim"



Wiley Post and some of the men responsible for his ship's equipment

An Interesting Group

IN our last issue we described Wiley Post's altitude suit which he will use in his high-altitude flight in the London to Australia race. One of our present photographs shows Mr. Post standing in front of his Lockheed aircraft *Winnie Mae*. With him are E. G. Molleukopf, his personal mechanic, D. S. Smith, President of the Westport Manufacturing Company which built a special radio set for this flight, and Paul O'Connor, Chief Engineer of the Westport company.

The flight is to be made at 30,000 feet and it is quite a problem to supercharge sufficiently at this altitude to maintain full ground horsepower of the engine. Two superchargers in series are employed, one (shown in the photograph) above and behind the engine. The powerful compression process involves a further difficulty: the air becomes too hot for most efficient use. Hence air coolers are put into the circuit between the two superchargers.—*A. K.*

Two More Electrical "Roofs" Over Earth

TWO new "roofs" of ionized electrical particles far above the earth are suggested by Dr. Harry Rowe Mimno of Harvard University in a letter to the British scientific journal, *Nature*, just published. Experiments on the reflection of radio waves indicate that echo layers "G" and "H" may soon be added to the layers "E" and "F" already known to science.

Electrical "roof" G, Dr. Mimno indicates in his communication, is probably at an altitude of 375 miles above the surface of the earth. Layer "H" seems to be at a height around 725 miles.

The already known layers are at an altitude of 62 miles and 155 miles.

Reflecting layers of ionized, or electrically charged, air molecules high above the earth have been known since 1902 when Professor A. E. Kennelly of Harvard University and Professor O. Heaviside in England independently came to the conclusion that such layers must exist to explain the long-distance transmission of radio waves.

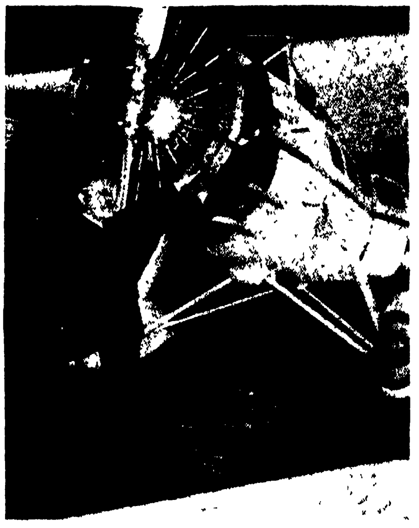
The reflecting layers are now called the Kennelly-Heaviside layers in honor of these two men. Ordinary broadcasting is commonly reflected by the lowest of the reflecting layers, at 62 miles.

Within 50 or 100 miles of a powerful broadcast station the reflecting layers are not needed for reception because the "ground" wave has sufficient intensity. Beyond this range, however, reception is possible only because the radio waves go up to a reflecting layer and are then turned back down to earth as if they had hit some radio mirror.—*Science Service.*

Broad Program of Tin Research

FOLLOWING out an extensive and continuous research program in the world's principal tin-using countries, The International Tin Research and Development Council has announced definite plans for carrying on this work in the United States.

On the recommendation of D. J. Macnaughtan, Director of Research for the International Council, the Battelle Memorial Institute, Columbus, Ohio, has been appointed to conduct research projects on tin in this country. Work is reported to be well under way, following such lines of investigation as will be of the greatest value to American manufacturers who employ tin for various purposes.



Post points to one of the radiators which are to cool supercharged air

As Mr. Macnaughtan pointed out in an address to the American Tin Trade Association not long ago, an analysis of the major applications of tin in industry reveals the fact that its chief use is in conjunction with copper, lead, and steel, and in the production of these metals the United States leads the world. A wide application in the use of tin is also found, in this country, in the form of chemical compounds affecting many industries. Technical problems, covering a number of new uses, will also be studied.

Air Markings for Bridges and Transmission Lines

BRIDGES, causeways, transmission lines and other structures over navigable waters of the United States are now required to be provided with lights and other signals for the protection of air navigation, the Bureau of Air Commerce, Department of Commerce announced recently. Responsibility for installation and maintenance of the lights and signals is charged to owners or operators of the bridges or other structures by an amendment to the Air Commerce Act of 1926, passed in the session of Congress recently adjourned. Types of markings to be used are to be prescribed by the Secretary of Commerce.

The Corps of Engineers, War Department, which issues permits for all structures crossing navigable waters, has stipulated that if the display of lights and signals on any work authorized is not otherwise provided for by law, such lights and signals as may be prescribed by the Bureau of Lighthouses, Department of Commerce, shall be installed and maintained at the expense of the owner.

On this authority, the Department several years ago issued "Recommended Standards for Marking Obstructions to Air Navigation." Clothed with more direct and explicit authority and jurisdiction, the Bureau of Air Commerce now is studying the entire matter with the view to promulgating regulations to carry out the terms of the new law.

Super-Speed in Aviation

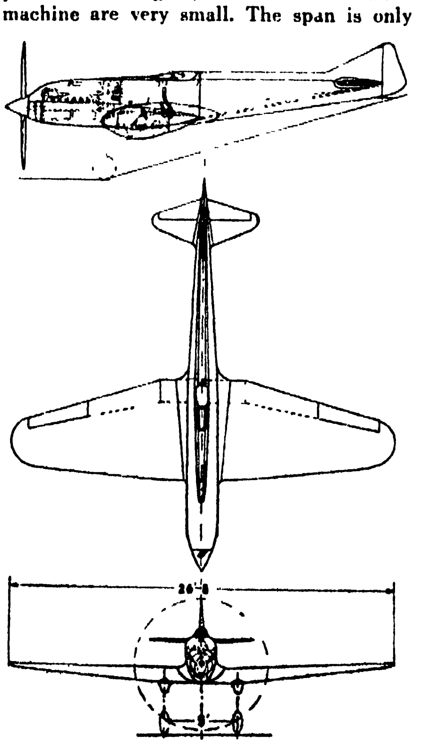
TO date, the world's speed record is held by the Italian Schneider Cup racer, which, while it did not win at the Schneider Cup Races, subsequently flew at 423 miles an hour.

Thanks to the courtesy of *Popular Aviation* we append a three-view photograph of a projected racer designed by Keith Rider, who already has several high-speed machines to his credit.

It is proposed to employ a "V" type, 16-cylinder, 2500-horsepower engine, which is at the drawing-board stage in the hands of Harry Miller, well-known for his racing cars

Even though both plane and engine are as yet only "on paper," the project is well worth study as showing what may be expected in the line of speed in the near future.

First of all, in spite of the tremendous power of the engine, the dimensions of the machine are very small. The span is only



Three views of a new plane designed especially for "super-speeds"

26 feet, 8 inches, and the overall length is only 27 feet, 9 inches. The approximate weight is given as 3000 pounds. This means, of course, that the engine will have to be exceedingly light and will probably not stand up very long; it will be essentially a racing engine.

The landing speed is given as 85 miles per hour. This will be realized by the aid of flaps. A variable-pitch propeller is to be embodied in the design, so as to facilitate take-off. The fuselage diameter will be only 40 inches—just big enough for a pilot, with no excess room.

Since the engine requires so much cooling surface, a cooling system will be used in which steam will circulate through a heat removing condenser under pressure.

With a 9-inch pitch propeller at wide open throttle, the engine will consume one gallon of gasoline every 15 seconds, and only enough fuel will be carried for a flight lasting 40 minutes. However, in that short period of time, it is estimated that the airplane will travel 300 miles.

While this project may look too ambitious, it is our opinion, based on previous study of this topic, that with careful engineering, both plane and engine can be realized, and that speeds in excess of 465 miles per hour may be attained.—*A. K.*

Aluminum Paint Pigment in Paste Form

PIGMENT for aluminum paint is now available in the form of paste as well as powder, as a result of several years of experimental work in the laboratories of paint manufacturers. Paste offers the advantage of drying to a very smooth finish which does not collect dirt readily and which remains clean and bright, even in industrial atmospheres. Also it is more convenient to mix with the vehicle because it eliminates loose powder flying about during mixing.

Adequate Helium Supply for U. S.

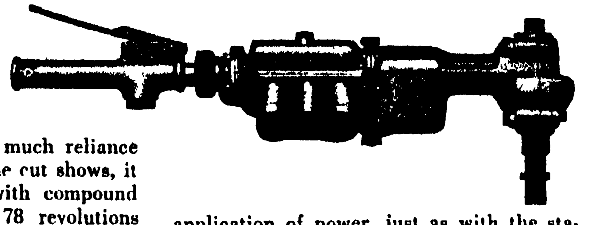
THE acquirement of all gas rights in 50,000 acres comprising the Cliffside helium-bearing gas field near Amarillo, Texas, has been completed by the United States Bureau of Mines. This field supplies the raw material from which all helium used in the nation's military service is extracted. In addition to supplying current requirements, the field provides a large reserve for future lighter-than-air craft operations of the Army and Navy.

With the responsibility of providing helium placed upon it by the Congress, the Bureau of Mines made a thorough study of the Cliffside field and considering all factors, determined that this field was the best reserve of helium-bearing gas then known. No comparable field has ever been discovered.

Production of helium at the Amarillo plant was started in April, 1929. In five years of operation, this plant has produced more than 57,000,000 cubic feet of helium, or about one half of all of that element ever recovered in the world. Operating costs have been less than one third of the lowest cost at which helium was ever obtained by the government from any other source.—*A. E. B.*

A Convenient Airplane Starter

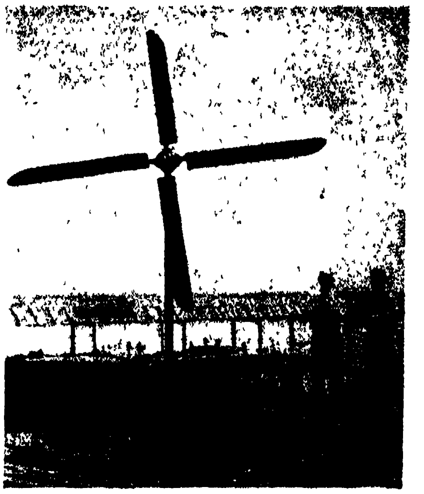
A USEFUL item of equipment around the hangar is a new engine starter developed by the Cleveland Pneumatic Tool Company, and illustrated on this page. This is another device to avoid swinging the propeller, and to avoid too much reliance on the built-in starter. As the cut shows, it is a piston-operated drill with compound gear reduction, driving at 78 revolutions per minute a spindle which is attached directly to the engine crank shaft. The piston operates under a pressure of between 80 and 125 pounds per square inch, and the whole instrument can be conveniently held in the mechanic's hand.—*A. K.*



Compressed-air starter for turning a plane "prop"

Novel Use for the Wilford Gyroplane

THE Wilford gyroplane is not unlike the autogiro, but its feathering is about the main axis of the blade and not about a transverse axis. It has been pronounced of equal aerodynamic interest by experts of the National Advisory Committee for Aeronautics. In spite of a recent accident, experimentation of real value is proceeding with this type of rotary aircraft. The gyroplane rotor develops lift in a wind without application of power, just as with the stationary airfoil or with a sail. This lift is quite powerful for a given diameter. Therefore the application of the gyroplane to boat propulsion is a logical matter.



An application of the Wilford gyroplane rotor to marine propulsion

One of our photographs shows an outboard motor boat hull equipped with the gyro in lieu of a sail. The rotor is 12 feet in diameter, and tested in 5 and 10 knot breezes gave as much propulsion as a sail of similar projected area. The gyro is mounted on a tubular steel mast, on the top of which is mounted a hub and brake. The plane of rotation of the gyro can be swung to various angles relative to the wind, so that the boat can sail before the wind, on the wind and with wind abeam—just as in a sail boat. Manipulation of the gyro in correct relation to the wind is of course much easier than that of a sail. Instead of reefing the sail, the gyro will be braked, since its lift is so much smaller when rotating slowly or when stationary.—*A. K.*

Waxing the wings of an airplane to obtain the maximum possible speed. Mechanics are applying a coating of wax to the wings of a twin-engine Boeing transport ship. The fuselage is similarly treated. Three miles per hour more speed is claimed

Black Lightning

PHOTOGRAPHIC enthusiasts who go in for lightning photography sooner or later find a curious effect in their pictures. "Black lightning" shows up on the prints as one or more streaks of dark hue, sometimes in combination on the same print with the more usual "white" lightning. The following explanation of this phenomenon was prepared for our readers by the Eastman Kodak Company:

". . . This effect is well-known as the 'phenomenon of black lightning' and is due to what is known as the Clayden effect. It occurs in general in photographs which are

made of electric spark discharges, of which lightning is an example. It consists of a reversal in the under-exposure portion of the characteristic curve and is usually observed when the photograph of the lightning is followed by a uniform exposure to light. This would occur, for instance, if the camera were pointed out of the window and after one lightning flash had been recorded, a second one occurred in such a way as to give a uniform diffuse exposure over the first one, or if there were a uniform exposure to the light from the night sky after the first flash had been recorded. Very little is known about this effect since it bears no relation at all to ordinary solarization. The fact that some flashes appear white for a distance and change to black, is probably the result of varying exposure along the flash."

Oil Explosion and Fire Test Arc Welding

AN oil explosion followed by fire recently destroyed the arc-welded steel structure of the Spring Perch Company, Lackawanna, New York, without causing failure to any of the welds used in its construction.

Twisted and bent by the terrific explosion and heat of the flames, trusses and bar joists of the one-story mill building formed a contorted mass of steel on the factory floor. Examination of the ruins failed to disclose any welds which had given way.

The structure was built in 1932 with framework entirely of arc-welded steel. Wide span trusses, bar joists, purlins, roof deck, and window sash were welded by the arc process using equipment manufactured by The Lincoln Electric Company. The Buffalo Tank Corporation had the contract for the welding.

The explosion which destroyed the structure proved a rigid test of welded construction and indicated the unusual strength of welds made with the arc.

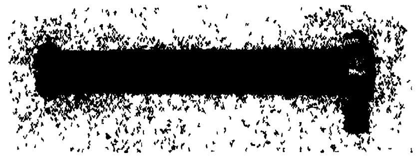
The U. S. Expands!

THE cities of Washington and San Diego seem to be giving each other the cold shoulder. According to Naval Observatory Astronomers, these two cities were about 40 feet farther apart in 1933 than they were in 1926. This is said to be due to a shift in longitude but some doubt has been expressed as to the accuracy of the calculations. It wouldn't do for the country to spread out too much and spill into the oceans!

Inexpensive Spectroscopes

A NUMBER of inexpensive spectroscopes are available for use in the laboratory and by the student and amateur astronomer. These instruments use a celluloid replica of the diffraction grating instead of a prism for dispersion of the light. While such instruments are not as sensitive to faint sources of light as are prism instruments of the same aperture, they have the advantage in that the spectra are not crowded

***Left:* A scale type grating spectroscope. *Below:* A direct vision grating spectroscope. Described in text**



in the red as are the ordinary prismatic spectra.

They are offered in several types, including a type having a wavelength scale, a direct vision type with adjustable slit, and an instrument which fits within the telescope eye-piece tube. This latter instrument will show the prominent absorption lines of the solar spectrum and if used with a fairly large reflector, will show the brighter star spectra as a series of colored dots.

Vitamin C Being Manufactured

SYNTHETIC vitamin C can now be manufactured on a commercial scale. Discovered some months ago, the process for this (the first chemical synthesis of any vitamin) has been so elaborated and improved upon that actual production of vitamin C on a large scale has been achieved. The new synthetic product has been named Redoxon.

This news is of particular interest in connection with the recent discovery that intravenous injection of vitamin C gives promise of proving a cure for a number of diseases which have previously defied the doctors' best efforts. Announcement of this discovery was made by Professor A. Szent-Gyorgy, distinguished Hungarian scientist, to a recent meeting of the British Association for the Advancement of Science. Among cures accomplished he cited cases of purpura, hemorrhages and Werlhoff's disease, which shows itself in dangerous bleeding, chiefly from the nose or mouth; nephritis, and certain non-inheritable forms of haemophilia, a mysterious bleeding disease, which in its hereditary form afflicted the former royal families of Spain and Russia. Addison's disease, with its abnormal bronzing or blotching of the skin, has also been conquered by injections of the vitamin, the professor said. And by a single injection—or three at the most—he asserted, physicians in Hungary and Germany have been able to check and cure pyorrhea.—*A. E. B.*

Good Paper Important in Braille Books

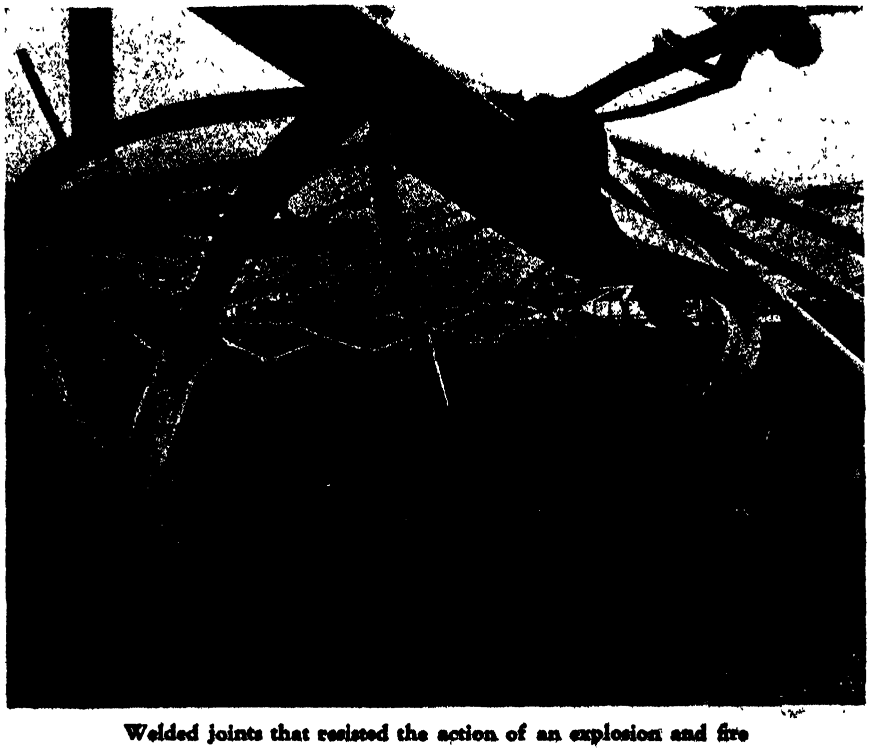
EVEN the blind can notice faults in the paper of their books. The National Bureau of Standards has just completed an investigation of books printed in Braille, the raised-type method of printing which permits deft finger tips to "read."

Paper that is too hard gives the raised dots harsh, cracked surfaces irritating to the reader's fingers, it was found. Some other papers are too soft and the Braille dots on them are not strong enough to prevent being ironed out under the reader's fingers.

Results of the study will be used by the Library of Congress to set up a uniform, high-quality standard of books for blind readers.

Braille process printing is accomplished by two methods, the wet and dry. Dry printing, as the name implies, is done on dry paper and the dots on the surface of the pages are not permanent. The use of this method is limited to magazines and papers of only temporary value.

In the wet method, the paper is moistened uniformly and after printing allowed to dry in racks. This is more permanent if done



Welded joints that resisted the action of an explosion and fire

on the right kind of paper, and the books can be read many times without having the dots become "dim and illegible."

Tests with small weights of about four ounces were used to determine how well the dot-like markings on the paper stood up. It was found that the paper with the greatest tensile or pulling strength was the kind which stood up the best. The dots on strong paper have a long life, and yet there is no tendency for them to crack at the top and form edges irritating to the reader's fingers.—*Science Service.*

Uncle Sam Enters Fertilizer Business

DURING the World War, the United States Government erected two plants at Muscle Shoals, Tennessee, for the manufacture of nitrates to be used in explosives. Since 1918, these plants have lain idle in spite of many proposals for their peace time utilization. Now, however, as a part of the War on Depression, Uncle Sam, through the Tennessee Valley authority, proposes to utilize the Muscle Shoals chemical factories but instead of producing nitrates for explosives, it is planned to manufacture phosphates for fertilizers.

Dr. Harry A. Curtis, chief chemical engineer of the TVA is the man who made the decision to scrap the whole idea of using the Muscle Shoals nitrate plants for their original purpose. "The fact is," he says, "that since these Government factories were built, new processes for the fixation of atmospheric nitrogen have been developed to such a point that the plants built at the time of the World War are now obsolete." America can now manufacture cheap nitrates adequate for any conceivable demand. One of the other essential fertilizer ingredients, however, phosphate, has lagged behind because the conventional method of treating phosphate rock with sulfuric acid is cheap and easy. Dr. Curtis, however, hopes to improve on this process by manufacturing the cheapest phosphoric acid possible as the starting point for the manufacture of the most concentrated fertilizer.

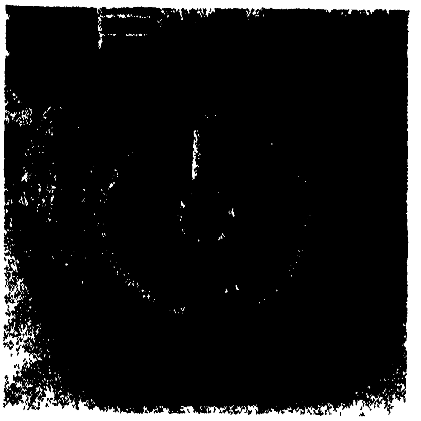
"We are converting two of the carbide furnaces in the nitrate plant at Muscle Shoals into phosphate furnaces," says Dr. Curtis in an interview in *Chemical Industries.* "In the meantime, we are building a plant to produce triple super phosphate fertilizer which will run as high as 54 percent P_2O_5. With important deposits of phosphate rock right in the middle of Tennessee I think we can make concentrated super phosphate cheap enough for fertilizer use." —*A. E. B.*

Cooling Motor Truck Tires

NOTWITHSTANDING the fact that all truck and bus operators are only too familiar with the destructive effect of heat in dual tires, little has ever been done about it.

Recently, however, Rogers Brothers Corporation, trailer manufacturers of Albion, Pennsylvania, requested The B. F. Goodrich Company of Akron, Ohio, to test the performance of a new type of cooling fan which they had invented and on which patents are now being taken out.

The actual effectiveness of the fan as tested is shown by the fact that the cooling effect lowered rim temperatures 50 percent more than the plain duals could dissipate under identical conditions. Translated into service performance on the basis of 50 percent more rapid heat dissipation, a wheel equipped with the Rogers fan would experience less temperature rise than the uncooled wheel during brake applications and, in motion, would cool to normal temperatures



Fan to cool truck tires

33 percent more quickly than the latter. Roughly, 50 percent more frequent or 50 percent more severe brake applications would then be possible without raising the rim temperature above that of the plain wheel in normal service. Dangerous tire burning, due to dragging brakes, would be minimized by the extra cooling of the fan.

Amateur Seismology

AFTER the earthquake of March, 1933, which shook Los Angeles and her neighboring communities, the study of seismology became more popular than it had ever been before in that locality. On this page is a photograph of two high school students and their local shock recorder, which was made by following drawings published in SCIENTIFIC AMERICAN, November 1929. This photograph was made available by Mr. M. H. Compton, teacher of physics in the Phineas Banning High School at Wilmington, in the Los Angeles City High School District, who writes:

"For rather well known reasons there has been much more interest in and around Long Beach, in earthquake study, since March 10th of last year than heretofore. I am inclosing a snapshot of a seismograph made by the boys in our high school, particularly Norman Thornton and Harold Schiffer, who are shown in the view. In the construction, we followed the plan given in SCIENTIFIC AMERICAN of November, 1929, by Dr. T. A. Jaggar, excepting the clockwork. Our clock was salvaged from a creamery thermograph. It has to be wound and set by hand daily. The protecting top of our device has been removed for the picture and is serving as a support for the heavy two-inch base-board.

"The brickwall background is an entrance wall of our school, the top stones of which were destroyed by falling cornice stones during the March 10th shake. However, with the removal of roof decorations, earthquakes have no terrors for our high school seismologists, several of whom would welcome further opportunities to observe the working of our apparatus under shakes of varying magnitude."

Hoped They Would *Not* Strike Oil

"WHEN a big petroleum company drills a well over 3500 feet down to the granite core of the earth and hopes to goodness that it will not strike oil, that's as much news as when a man bites a dog," says Williams Haynes in *Chemical Industries.* "Yet, that is exactly what the Texas Company did near their large refinery at West Tulsa. That curious wish was fathered by a clever chemical thought worked out by the late Dr. Otto V. Martin. Knowing that there were great reserves of salt brine under the refinery and that the refinery sorely needed more abundant and cheaper supplies of water for cooling, he combined these facts and figured out a method to evaporate salt by chilling in complete reversion of all existing processes. The Martin process . . . is just as simple as that—the brine is pumped up by compressed air and sent through the cooling system of the refinery where it absorbs heat. The heat-

Amateurs with a seismograph made from directions published in *Scientific American*

ed brine is sprayed out through a long series of fine nozzles over steel lined tanks and the fine mist in the cool air results in rapid evaporation of the water. The salt drops out and settles to the bottom of the spray ponds. Here it is scraped up and carried by bucket conveyors and rubber belts through a series of dryers, washers, dryers again, and finally to the storage bins."

Salt is the main product of this plant, but bromine, Epsom salts and calcium chloride are also produced in the same process.—*A. E. B.*

Lightning Strikes Twice—And Even Ten Times—In One Place

"LIGHTNING never strikes the same place twice" is another saying that definitely has been disproved. Engineers of General Electric's high-voltage engineering laboratory staff at Pittsfield, Massachusetts, have obtained a series of photographs that prove lightning to be more than a single flash of high-voltage electricity between cloud and earth.

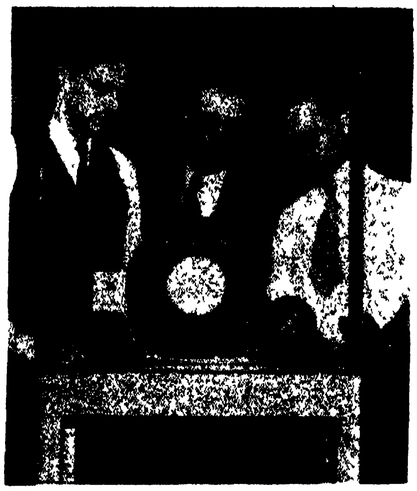
The photographs were obtained with a special type of camera in which the film is

Camera for lightning research

whirled past the lens at a speed in excess of a mile a minute. The result is that there is a time scale along the length of the film, and readings in millionths of a second are possible.

On a recent evening at Pittsfield there was a severe electrical storm. The engineers set up their camera, pointed it toward that part of the sky where the flashes were particularly prominent, started the electric motor which whirled the film past the lenses, and removed the lens cap. In a few moments the men felt sure they had pictures of at least a few flashes; so the lens cap was replaced, the camera removed to the photographic developing room, and the negative processed. The men had been particularly successful, for the film revealed photographs of 10 separate strokes to ground, and one of these strokes was a multiple flash of 10 recurrent discharges over the same path.

Study of the series of 10 recurrent discharges showed that, except in the case of the first one, each discharge had a certain type of "leader" stroke traveling from the cloud to the earth. This stroke, relatively weak on the film, was immediately followed by a brilliant, powerful flow of the energy in the other direction—from earth to cloud—over the path already cut by the "leader." Following this bright flash the film showed illumination for approximately 1/2000th second. Then there was a pause of a matter of a few millionths of a second, whereupon another "leader" discharged from cloud to earth, with another immediate stroke from



***Left to right:* Engineers McMorris, McEachron, and Lloyd have taken many high-speed lightning photos**

earth to cloud. In rapid succession there were 10 such discharges, all in general being like the preceding ones. All of them occurred in a small fraction of a second—so rapidly that the human eye or usual camera would be unable to follow them.

Observers frequently notice that strokes of lightning are branched or forked. The film showed that the streamers were confined to the first discharge only; thereafter the flashes followed the main path only.

Knowing the velocity of the film, the focal length of the camera lens, and the size of the photographic image, and being able to determine the distance away of the stroke—either by calculation from the time between the flash and the thunder or by happening to know where the bolt struck—the engineers have been able to determine numerous properties of the recorded strokes. They have calculated, for instance, that the "leader" travels at a rate of from 14 to 38 feet per microsecond (1/1,000,000th second), and the main stroke up from the earth at from 73 to 180 feet in that time (light travels approximately 1000 feet per microsecond).

Since the "leader" appears to have slight illumination when compared with the main stroke, the engineers have interpreted it as existing in the form of a dart—not as continuous from cloud to earth.

The device with which the photographs were obtained is known as a Boys camera. It was recently lent to the General Electric engineers by A. P. Loomis, of Tuxedo Park, New York. A small motor drives a rotating drum 29 inches in circumference, to which the strip of film is attached with its emulsion side toward the center. Near the center are two matched lenses with prisms so that simultaneous photographs are obtained on opposite sides of the drum. The direction of motion, and the images, are reversed. Differences in distances between corresponding parts of pairs of images are used in obtaining the time measurements. The speed of rotation of the drum can be varied according to the requirements of the work; in obtaining the lightning pictures a speed of 3000 revolutions per minute was used.

The photographs were obtained by W. L. Lloyd and W. A. McMorris of the Pittsfield laboratory.

"We believe these pictures to be outstanding," says K. B. McEachron, head of General Electric's high voltage investigations at Pittsfield, "since they so well corroborate the recent work of Dr. B. F. J. Schonland in South Africa. Working with a somewhat similar type of camera (in which the lenses rather than the film were rotated) he also obtained a photograph of a multiple discharge. The pictures now obtained at Pittsfield, with different equipment, prove that lightning discharges are the same throughout the world. Work with the Boys camera is to be continued at Pittsfield, in the hope of obtaining further interesting data regarding lightning, its characteristics, and methods to reduce its destructiveness."

Skating on Water

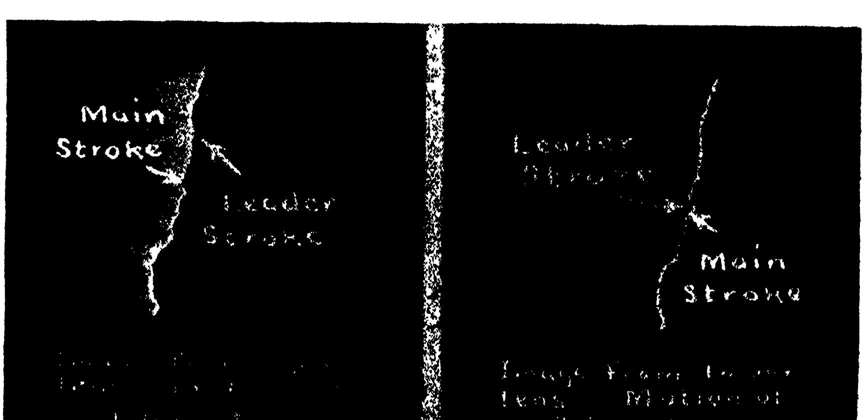
A SKATER on a frozen lake does not skate on ice but on a thin film of water. This is simply elementary physics. Under pressure the freezing point of water is lowered; and on a frozen lake the skate runners provide the pressure.

Anesthesia Aided by New Drugs

NEW investigations in hypnotic drugs producing a degree of insensibility between normal sleep and complete surgical anesthesia have recently been reported to the American Chemical Society by Drs. E. H. Volwiler and D. L. Tabern, of the Abbott Laboratories, Chicago.

Previous work with derivatives of barbituric acid has produced drugs of the neobutal type, now widely used in hospitals for patients before an operation and prior to the administration of a total anesthetic.

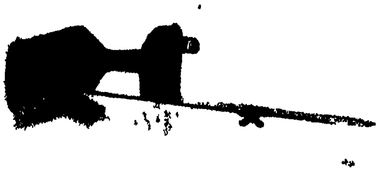
Such drugs, when given by mouth in prop-



Two lightning photographs taken simultaneously with the Boys camera

er doses, produce a relaxed condition in the patient, without causing complete insensibility. While under their influence the patient could be given ether or other anesthetics, and could co-operate with the physician in the process. The desired insensibility came quickly and lasted only a little longer than the operative period; hence decreased possibilities of post-operative complications.

Another major improvement in the barbiturate drugs was to increase the margin of



The "gun" stock made for a movie camera, as described on this page

safety between an effective dose causing insensibility and a fatal dose. Drs. Volwiler and Tabern observed that these specific effects of the barbiturates were associated with a certain arrangement of the atom groups within the molecules of the compounds. They determined to study the properties of other substances into which these groups might be incorporated.

Substituted acetyl ureas, acetamides, and brom analogs were employed. In all, 27 different drugs were prepared. Some of these new preparations had unusually wide margins of safety. However, while their study may aid in increasing the knowledge of what factors are needed to raise the safety margin in hypnotic drugs, the scientists feel that the newest compounds described by them are not yet ready for clinical application.—*Science Service.*

"Gas" by the Dollar's Worth

NEW pumps now being introduced make it easy to sell "gas" by money's worth or tank capacity rather than by the gallon. Dials indicate cash as well as gasoline. One type of pump has a small dial for the gallons, a large one for the cash and the price; another type features a dual-dial recorder in which the price clip controls the cash recorder; and a third type has figure instead of clock type dials to avoid any error when the hand type is viewed from one side.

A Movie Camera "Gun" Stock

WHEN the depression hit the Army, writes Major F. T. Chamberlin, in *Field and Stream*, heart balm—or something—was given in the form of a month's leave, without pay. With time on his hands, he decided on a hunting and fishing trip, together with his movie camera and three companions. Some time previous to this, Major Chamberlin had discussed with Dr. Louis B. Wilson, Director of the Mayo Foundation, a "gun" stock for use with a motion picture camera, and Dr. Wilson had sent him photographs of such a contraption.

"The night before we left," writes Major Chamberlin, "when I should have been packing, I suddenly became obsessed with the idea of 'stocking' my camera and proceeded to develop the ideas on the stock that had been lying dormant for two years, stealing, I'm afraid, more than a few from Dr. Wilson's photos.

"I have a fairly well-equipped workshop in the way of tools, but that night, when time was at a premium, I found I was mighty short on material. However, I dug up a piece of yellow pine, 1¾" by 10" and started hysterically to hack out a stock. This was accomplished in a very short time, as can probably be judged from its appearance in the photo.

"The method of attaching the stock to the camera was not so easy and, besides, I didn't care about drilling holes in the camera case as Dr. Wilson had done with his.

"I cut a strip of ⅛ inch brass two inches wide, bent it at a right angle and fastened it to the stock with four brass screws. A strip four inches long and one inch wide was then annealed, bent to grip the rear end of the camera, and held in place with two screws. A ¼ inch hole was then drilled through the bottom of the long strap under the screw hole for the tripod in the camera and a screw having the same thread as that for the tripod was turned out on the lathe and a pair of wings soldered on.

"To mount the camera it was only necessary to push the rear end into the jaws on the stock and fasten it by the one screw in the tripod hole.

"As the brass had a little too much spring for the weight of the camera, a piece of ¾ by ⅛ inch steel was riveted under the brass strap and fastened to the end of the pistol grip by a screw. This made an absolutely rigid stock that could be mounted or dismounted in half a minute without changing the camera in any way.

"As I was not using a telephoto lens, there was no reason to use a peep sight as on Dr. Wilson's job.

"The work was completed in less than two hours, including the cussing. It wasn't a thing of beauty and I didn't feel like taking time out to checker the grip and put on a recoil pad, but it filled the bill.

"We arrived at our destination two days later on one of the old south Georgia plantations in the middle of the state, near the Florida line.

"Early the next morning, after one of those southern breakfasts that remain long in your memory, we started out chiefly to 'shoot the camera.' One of the darkies from the plantation carried the contraption and we alternated with the shots, after the formality of flipping a nickel to see who got the first shot with the gun or camera. Later, when we dropped down to the Gulf for fishing, the same system obtained.

"Aside from the pleasant memories of a most enjoyable trip, we brought back 500 feet of as fine hunting and fishing pictures as I have ever seen.

"This stock was as easy to handle as a gun and, although three of the party had never had a movie camera in their hands, let alone work one, there was not a blurred picture in the bunch. In no case were there pictures without the subjects in the field.

"In passing, I would say for the benefit of the brother who may decide to rig himself one of these stocks: Use it in the wide open spaces, where men are men, etc., and not in the wicked cities, as some cop, well-meaning citizen or gangster might decide that you are on the verge of starting a little one-man revolution or about to 'bump off' a friend. It sure looks like one of 'them double-actin' machine guns in the paper', as one old darky said after watching us take some pictures about the plantation."

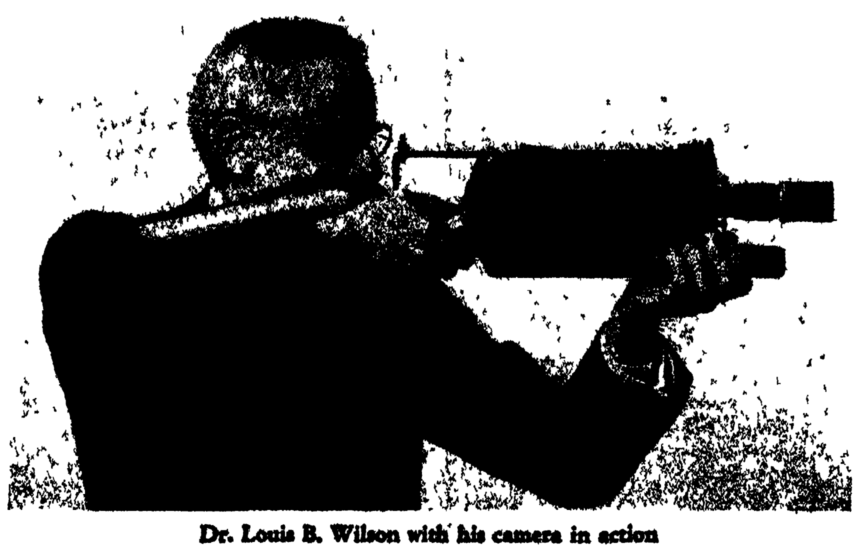
Tonsil Removal

CHILDREN subject to tonsilitis, enlarged glands of the neck and ear troubles are most benefited by removal of the tonsils, Dr. Albert D. Kaiser of the University of Rochester School of Medicine found from a study of a large group of children for a period of ten years. Head colds and infections in the chest, on the other hand, were not benefited by removal of the tonsils. Tonsils may be large without causing any trouble and mere size is no reason for removing them.—*Science Service.*

Food-Stuffs Field Beckons Chemists

CONSIDERING the billions of dollars that America spends for food, we really have pathetically little definite scientific knowledge about food-stuffs. Says Arthur D. Little's *Industrial Bulletin:*

"Many dietitians still evaluate foods on the calory (heat-producing) basis, and may or may not go so far as to recognize the need of providing the calories from foods of various types, including protein. Some recognize the functions of the various vita-



Dr. Louis B. Wilson with his camera in action

mins, and occasionally, the need for mineral constituents. Certain individuals seem to need much bulk in their food, whereas others may be irritated by bran and even spinach and other bulk-producers, but, if the fad of the moment is to have bulk, it will go into many diets. While a few progressive investigators now distinguish between the various kinds of proteins and their relative importance to the person or animal, there is still a long way to go in understanding the chemistry of foods, even without regard to the peculiarities of the needs of individuals.

"Butter fat, for instance, is not at all simple, for one investigator was able to separate it into some 37 fractions. Some of these parts may be of far greater importance than others. Further, the composition must vary greatly with the feed of the animal, as is known to be true of other fats. Recently, milk is being 'softened' as water is softened, to remove some of the excess lime, which is apparently of more utility to the calf than to human babies. Thus we still know very little about such an important food as milk, and the situation is hardly, if any, better in the cases of grains and various other foodstuffs.

"It is still necessary to use rats and other laboratory animals to measure the vitamin values of foods, for adequate routine chemical determinations have not been developed. Relatively little is yet known about the hormones or chemical regulators of the body, although a salutary and determined assault is being made on this field by some splendid workers. Some of these hormones undoubtedly enter our bodies by way of food. By their intelligent use we may secure more control over our activities than we now can realize.

"Important and promising studies are under way pertaining to the nutrition and welfare of the human body. Enough has already been found to suggest great benefits to come, but also to suggest conservatism in making or accepting claims for universal beneficial effect for any one food product or ingredient. In this branch of human knowledge, we are still in a state of great ignorance."—*A. E. B.*

Blindness Due to Detached Retina is Curable

BLINDNESS caused by loosening of the retina, the actual seeing part of the eye, can be cured or at least benefited by operation in nearly 50 percent of all cases. So Drs. J. H. Dunnington and J. P. Macnie of New York City have reported before the meeting of the American Academy of Ophthalmology and Otolaryngology. The New York surgeons described their results in operations on a series of 150 patients.

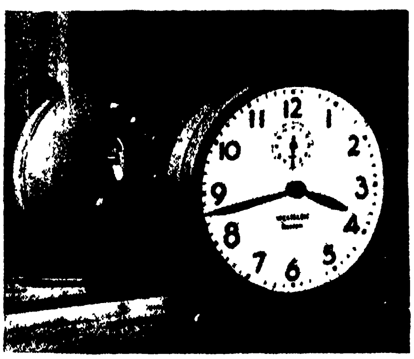
The retina, the light-sensitive lining of the eye, is an exceedingly thin, delicate film of living tissue. It may be compared with the photographic film or plate in a camera. It rests on a tissue called the choroid, which contains many blood vessels. From this the retina gets its blood supply.

Sometimes the retina becomes detached from the choroid, peeling off as wallpaper does from a wall. When this happens, the retina fails to get enough nourishment and cannot function properly. The patient feels as if a curtain were falling over part of his eyes and he has increased difficulty in seeing. The retina may not become wholly de-

tached, but if not treated it will as a rule eventually all peel off.

Modern treatment of detached retina is based on a method first proposed by a Swiss surgeon, Dr. Gonin. It is analogous to spot welding, the idea being to seal the retina back onto the choroid by cauterization, which produces an adhesive inflammation between them. One modern method of doing this is by driving tiny platinum-iridium needles into the choroid. These needles carry an electric current of from 30 to 50 milliamperes, which does the cauterizing. In early cases this method gives as high as 70 to 80 percent of cures. If the retina has been detached from the choroid too long, however, it loses its power to function, and the patient cannot see even after the retina has been re-attached. Consequently the greatest percentage of cures are among early cases.

The operation for treating detached retina is now being performed in all the major clinics in this country.—*Science Service.*



While an alarm clock is not usually "going somewhere" that it need be streamlined, this "air-flow" Westclox reflects a distinct refinement of design which follows the trend of modern transportation

Gas Attack Protects Oranges

IF oranges are subjected to a new kind of protective gas attack, storage damage from decay is reduced to a half or quarter of the usual losses.

The gas used by Dr. L. J. Klotz of the University of California's Citrus Experiment Station at Riverside is nitrogen trichloride. It promises to combat decay-causing fungi upon citrus fruits in storage rooms or in loaded cars of packed fruit.

Very small concentrations of this gas do the work satisfactorily. Equivalent concentrations of chlorine gas, while more toxic to the fungi, injure the fruit rind and open the door to greater losses later.—*Science Service.*

First Northern Grouse to Hatch in Captivity

NESTLING in a human hand, the little ptarmigan or northern grouse shown in the accompanying illustration is the first baby of its kind to be hatched in captivity.

Dr. A. A. Allen, head of Cornell's ornithology department, collected freshly laid ptarmigan eggs on an expedition to the Canadian outpost, Churchill on Hudson Bay. Bantam hens were persuaded to act as foster mothers in hatching the eggs which he rushed from Churchill to Ithaca. Out of 18 eggs set, only one hatched.

Just a handful of fluff, this grouse is the first to hatch in captivity

"Strong and doing well" is the nursery bulletin on this first captive ptarmigan baby.

The ptarmigan study is being made because of the similarity of this bird to the common ruffed grouse which has been studied by Dr. Allen for the past 10 years under the sponsorship of the American Game Association.

Scientists left by Dr. Allen at Churchill to continue the study of Canadian birds have sent back another set of 20 eggs which are now being hatched. Several eggs have already been broken by the foster hen mother, but it is expected that there will soon be more hungry mouths in Cornell's ptarmigan nursery.—*Science Service.*

United States Has Most Telephones

THE five countries of the world having the largest number of telephones are the United States, Germany, Great Britain and Northern Ireland, France, and Canada. These are the only countries having a total of more than one million telephones each.

A review of telephone facilities recently completed by the American Telephone and Telegraph Company shows that on January, 1933, the last date for which comparable figures are available, there were in use approximately 33,000,000 telephones. Of these, 17,424,406 or nearly 53 percent were located in the United States. Germany held second place with 2,960,401; third place Great Britain and Northern Ireland with over 2,146,409; France had 1,292,254; and Canada 1,261,245. Sixth place goes to the other side of the globe, for Japan had 965,390.

Besides having by far the greatest total of telephones of any country in the world, the United States also leads in ratio to population. This country had almost 14 telephones to each 100 of its population, and in this classification Canada jumped to second place with 12 telephones per 100 of population. New Zealand is third with 10 for each 100 of its people. Denmark is fourth with just under 10, and Sweden is in fifth position with almost nine and one half.

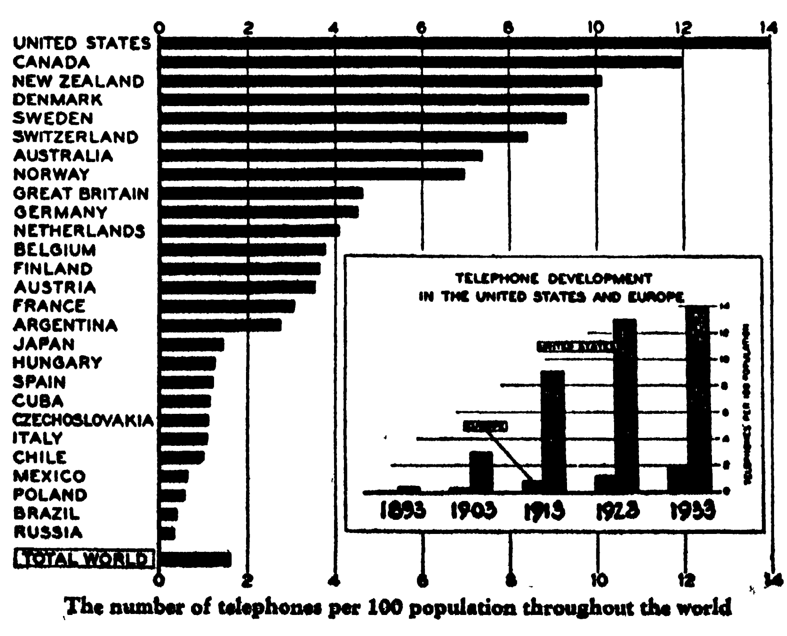
Rubber Putty

"PLASTIKON" putty, a compound similar in appearance and consistency to ordinary painter's putty, with the important exception that it is combined with rubber, is a new product being marketed by the B. F. Goodrich Rubber Company. Not only are most of the advantages of ordinary putty claimed for the new compound but the use of rubber is said to yield additional benefits. Of unusual interest is the fact that this putty requires no mixing, since it contains practically no oil. It effectively resists corrosive chemicals and fumes and, because of its rubber content, offers very high resistance to moisture. Another property, peculiar to this putty, is its high degree of adherence to steel surfaces.—*A. E. B.*

Medicine Given Through Skin

CERTAIN medicine is more effective in treating diseases of the blood vessels when induced to enter the body by the aid of an electric current than when given by mouth or by hypodermic injection under the skin, a group of New York physicians has found. These men, who recently demonstrated their method to the American Medical Association, are Drs. Irving S. Wright, A. Wilbur Duryee, Joseph Kovacs, Dean Moffat, and Joseph Wiener of the New York Post-Graduate Medical School and Hospital of Columbia University.

The medicine they use has the long name of acetyl-beta-methyl choline hydrochloride.



The number of telephones per 100 population throughout the world

It has been found useful in treating Raynaud's disease and certain other ailments, including chronic arthritis, because it improves the local circulation of blood.

When this medicine or similar ones are given by mouth they have little or no effect. When given by injection under the skin or into the muscles, the action is very transient because the medicine is quickly destroyed by the blood. When injected directly into the veins it is highly poisonous. But given by what the doctors call galvanic induction through the skin its effects are more prolonged and hence more satisfactory, they found.

While the treatment is not a "cure" for rheumatism or chronic arthritis, it gives striking results, reducing the swelling, increasing the general activity of the joints without pain and making the patient more comfortable.

An asbestos bandage soaked in the medicine is wrapped around the affected limb or joint. Over this is placed a flexible metal plate which is connected to the positive pole of a galvanic generator. A moist pad electrode placed on the back is connected to the negative electrode and the current turned on and slowly increased.

The electric current breaks the medicine down into ions which are carried, according to the principle of ionization, into the skin.

Because the medicine is slowly absorbed through the skin it does not have a poisonous effect as it does when injected directly into blood stream, Dr. Wright explained. But it does have a very striking effect on the circulation and other body functions. The blood pressure decreases and the pulse rate increases slightly. There is flushing and sweating and an enormous output of saliva. The basal metabolic rate, indicator of the rate at which the body is converting food into energy and tissue, also increases enormously. The temperature of the skin at the finger tips increases five or ten degrees.

As a result of all this, the rheumatic patients are more comfortable and can move their limbs more easily and freely. The patients suffering from Raynaud's disease or similar disturbance of the blood vessels have less pain, better circulation and rapid healing of the ulcers which are sometimes a feature of their ailments.—*Science Service.*

Engineering Construction Uses Refrigeration

DETAILS of an interesting use of refrigeration in foundation work has just come to our attention in connection with a complete report of the building of the vehicle and pedestrian tunnels under the Schelde River at Antwerp, Belgium. These two tunnels, of which that for vehicles is 5801 feet between portals and that for pedestrians 1750 feet, were begun in January 1931 and were officially opened in the fall of 1933.

It was necessary to sink the ventilation shafts at each end of these tunnels through water-bearing soil. To sink these shafts 70 feet in diameter and 87 feet deep, free from internal bracing, the ground was first frozen in a circle by a unique method. First, 116 holes were bored in two sets, one in a circle 86 feet in diameter and the second in a smaller circle of 78 feet, the holes being spaced on the circumference at distances of 4½ feet. In each of these holes, six-inch pipes, sealed at the bottom, were

sunk to a depth of 90 feet. Inside each outer pipe a two-inch open-ended pipe was inserted. Through this inner pipe a brine refrigerating solution was pumped downward. Reaching the closed bottom of the larger pipe, this brine escaped upward in the space between the smaller and larger pipes.

Four months of pumping brine through these pipes sufficed to create a solidly frozen wall surrounding the circular space which was to be excavated.

Our readers will remember that other instances of refrigeration in construction have recently been described in SCIENTIFIC AMERICAN. The most notable, perhaps, is the process of refrigerating the concrete of Boulder Dam as fast as it is poured in order to remove the heat generated by setting.

Ice Cream While You Wait

WHAT is probably the most rapid commercial ice-cream freezer in the world has been put on the market by a Los Angeles inventor. Ice cream and frozen novelties are produced in from 15 to 45 seconds.

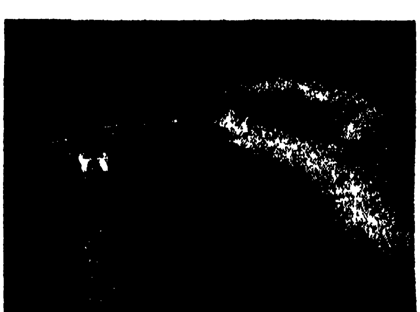
To make ice cream the mix is simply poured down a central hollow shaft where it is atomized by a spray spindle driven by a 1/64 horsepower motor, being sprayed against the walls of the chamber which are refrigerated to –20 degrees, Fahrenheit, with methyl chloride. The shaft head travels up and down, driven by a 1/15 horsepower motor, and as soon as the material has frozen sufficiently, a cutter head automatically removes it from the walls, molding and discharging it. This operation requires 30 to 45 seconds.

Frozen novelty confections can be produced almost as quickly. If the mix is poured in first and followed by fruit juice or fruit pulp, the finished product will be ice cream with a fruit core. These confections are free of disagreeable ice crystals and smooth in texture, because of atomization and instantaneous freezing.—*A. E. B.*

Multiple-Burning Christmas Tree Lamp

A NEW small multiple-burning Christmas tree lamp which, unlike the series type, does not affect the other lamps in a string when it burns out, has been developed by the Incandescent Lamp Department of General Electric Company at Nela Park, Cleveland, Ohio.

Slightly larger in size and using only a little more electricity than the well-known series-burning variety, the new lamp does not cut out the others of a string when it burns out. This eliminates the time and trouble always experienced with the series-burning string in finding the burned-out lamp



The multiple-burning Christmas tree light (left) compared with old

among eight that have become extinguished. Its longer burning life of 500 hours offers another advantage to the user. The new lamp has a candelabra screw base, and is designed for use on circuits from 110- to 125-volts.

How Ear Canals Control Body's Balance

CONCLUSIVE evidence showing exactly how the semi-circular canals inside the ears maintain the balance of our bodies was presented by Dr. J. W. McNally of McGill University, Montreal, at a meeting of the American Academy of Ophthalmology and Otolaryngology. The experiments he reported are said to be the first conclusive evidence for the theory scientists have held concerning the function of the labyrinth in maintaining balance.

On each side one of the semi-circular canals is horizontal and the other two are vertical. The horizontal canals are the ones

A real novelty in razors—a magazine type in which the sealed package of blades is a separate unit. *Left:* The key of the sealed magazine is inserted in a slot in the razor. *Above:* A slide on the magazine is pulled and pushed, ejecting the old blade from the razor and inserting a new one. When the key of the magazine is withdrawn, the new blade is automatically aligned. *Right:* For periodical thorough cleaning, the handle of the Schick razor is separated, scissors-like, releasing the upper blade-holding parts

having to do with turning movements from side to side. The vertical semi-circular canals and chambers called utricles keep the head level and steady and maintain the body's position once it is established.

The three semi-circular canals together are called the labyrinth of the ear, and Dr. McNally found from investigations on frogs that this labyrinth is essential for normal behavior and that even the simplest movement may stimulate all of the labyrinth.—*Science Service.*

Diesel Engine Cylinders Built By Arc Welding

BLAZING new trails in the construction of Diesel engines, F. B. Stearns, Cleveland, Ohio, is building an experimental Diesel embodying arc-welded cylinders for use in marine type engines. Since both weight and space are at a premium, castings were discarded and arc-welded steel used for the cylinders and other parts.

The design and arc welding of these cylinders was a difficult problem since some 16 pieces are required for each cylinder and the tolerance on the finished work was exceedingly small. The inner sleeve is of case-hardened steel and the outer portions of mild steel.

The arc welding was done by The Thornton Company, using welding machines and Fleetweld electrodes manufactured by The Lincoln Electric Company, Cleveland, Ohio. These are said to be the first arc-welded Diesel engine cylinders ever built.

Cod-Liver Oil for Industrial Workers

STUDIES by sick benefit associations, the Metropolitan Life Insurance Company, and the United States Department of Public Health show that over 40 percent of the lost time by wage earners is caused by colds and respiratory diseases.

During the past winter a study was conducted to determine the value of cod-liver oil for reducing lost time of wage earners caused by colds and similar troubles. Three hundred and eighty-nine men and women employed at a variety of tasks such as office work, light machine work and heavier machine work were fed five tablespoonfuls of cod-liver oil per week at their forenoon rest period. Three hundred and nine men and women of corresponding age, weight, general living conditions and employed at identical tasks did not receive cod-liver oil and thus served as controls. The experimental period was 20 weeks long.

The experiment showed that by feeding vitamin-rich cod-liver oil to average industrial employees the number of severe

colds can be materially reduced, the number of persons having no colds may be increased, and the amount of lost time from work may be very significantly decreased.

Air Conditioning May Increase Gold Supply

THE famous Robinson gold mine, in the Rand, near Johannesburg, has contracted for an installation of air conditioning equipment that is expected to make it possible for men to work at depths previously uninhabitable. Says *Industrial and Engineering Chemistry:* "The Rand produces about half the world's gold with the amount definitely limited by conditions in the deep mines, some of which already extend to 8000 feet below the surface. Here temperatures from 100 to 120 degrees, Fahrenheit, combined with a humidity from 90 to 100 percent, definitely limit operation, and while there is reason to believe that the richest deposits of gold lie at still greater depths, it has been humanly impossible to work them.

"The plan is to force dry, cold air, traveling at a rate of approximately 30 miles an hour, to the lowest parts of the mine. This will cool and dehumidify, as well as thoroughly ventilate, these remote depths where men strive for the precious metal. This first installation in the Robinson mine must be regarded as something of an experiment on which a half million dollars is being risked, but the chances for success are large and the return on the operation promises to be most gratifying. There are doubtless other instances where air-conditioning will allow further production of gold. We are told that in Nevada, for example, some mining operations were abandoned because of working conditions in the mines, even though not so deep as those in the Rand, rather than because of lack of ore.

"A great increase in the production of gold, according to the economists, would support amply any possible trade revival, enable the world to return to the gold standard, greatly restore confidence, and cause commodity prices to rise. In fact, it would quickly change the present world economic situation and multiply the number of those who can smile."—*A. E. B.*

Fooling the Fish

AFTER reading the article "Angling Has Scientific Angles," in our July number, Mr. Paul L. Rittenhouse of the United States Printing and Lithograph Company, Chicago, obtained some nickel chrome wire from the Gilby Wire Company, and used it as a fishing line during a recent trip. A report of the results obtained follows:

"Its advantages over silk line for deep trolling (as well as for shallow trolling) are quite interesting. The sensitivity to nibbles is an entirely new sensation—just exactly as though one were connected with the fish by a telephone line. It is obvious that because of the absolute lack of stretch in this wire, a very flexible rod must be used for sizable game fish from three to ten pounds weight, as the danger of pulling the bait out of the mouth of a game fish, which is usually lightly hooked, is much greater. . . .

"I not only failed to lose a single fish, but actually hooked every fish that struck, with perhaps one exception.

(*Please turn to page* 274)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

EXTREMELY few have made Gregorian telescopes, but Mr. W. F. Decker, whose romantic address is Mizzentop, Christmas Lake, Excelsior, Minnesota, has made one having an added reflection and a side-door eyepiece (non-perforated type). He describes it thus:

"The difficulty of making an optical flat or an accurate spherical mirror for testing purposes only, need no longer deter the amateur who has the ambition to make a compound telescope; these accessories are not absolutely necessary, as once believed. Kirkham's method of testing Gregorians from foci is entirely practical and within the capacity of anyone who can make a good Newtonian telescope.

"My first telescope, illustrated in the December, 1933, number of SCIENTIFIC AMERICAN, was a six-inch Newtonian. I afterward made an eight-inch, $f/9$, Newtonian which proved so much better than the first that I had no further use for the six-inch. It then occurred to me that I might use the six-inch tube for a small Gregorian.

"I decided, in the first instance, on a 6-inch $f/5$ primary, with a 1.75-inch secondary, making $p=7.5$ inches. These values are in proportion to Hindle's example in 'Amateur Telescope Making' and fit into my 54-inch tube as though it were made for them. It took just one month of my spare time to make the change, and I now have a good compound telescope of convenient dimensions and considerable magnifying power. Because of the small size of my primary, which was limited by the size of my old tube, I did not seek a very high magnifying power; but the new telescope is very satisfactory, and I feel amply repaid for the effort.

Mr. Decker and his Gregorian

"My Gregorian is of the non-perforated type. (See drawing.) I use a one-inch prism located about a foot from the primary mirror. This comes near enough to the declination axis to make the eyepiece always convenient. Instead of an adjustable adapter tube, I slide the block which carries the eyepiece tube between two of the strips of my wooden telescope tube, and pick up the focus wherever it may be. I have a thumb screw adjustment for accurate focusing.

"While it is necessary to keep rather closely to the values of f, p and p' employed in determining the RC of the secondary, the latter can easily be figured by Kirkham's method, even though f and p' vary slightly from assumed values. This is fortunate, for it is extremely difficult to keep these dimensions from varying slightly during final polishing and figuring.

"It is better, in this case, to keep the value of p constant, and absolutely necessary to figure the mirrors accurately.

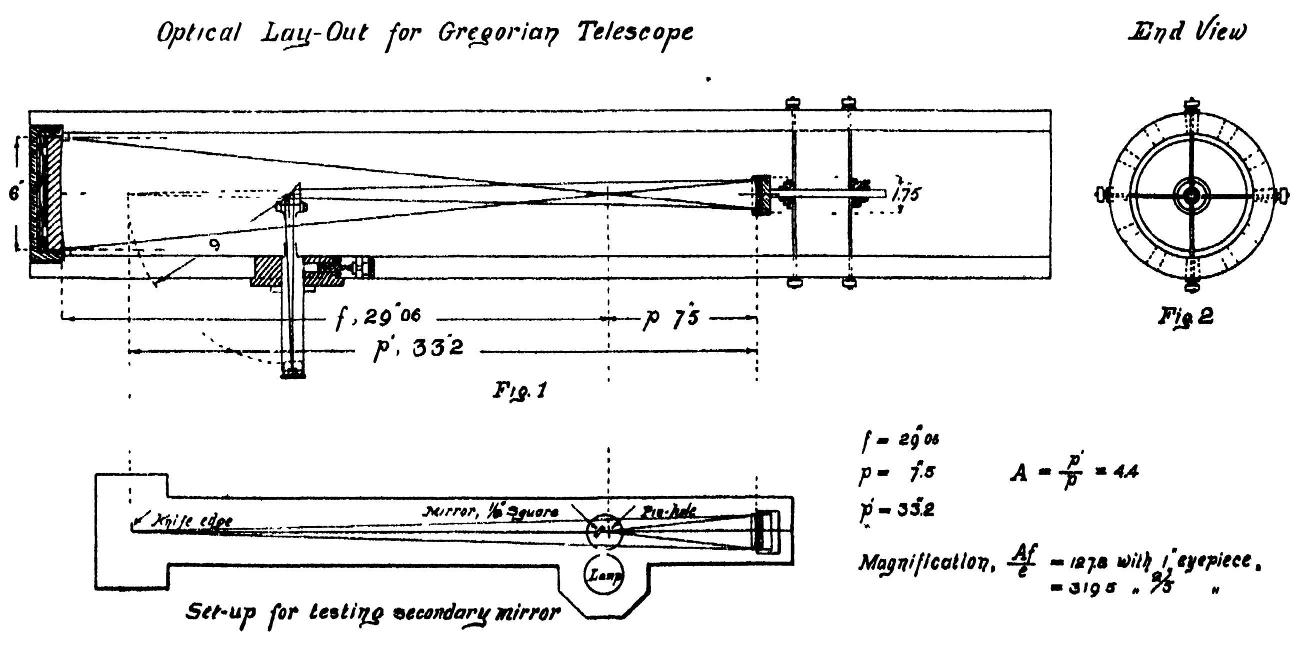
"The primary must be a true paraboloid and the secondary a true ellipsoid. It bothered me at first to know how I was to determine when the secondary was correctly figured; but I found it was only necessary to apply the test for a perfect spherical surface; in other words, an *apparently* flat surface, with the pin hole at one focus and the knife edge at the other. In such a test an ellipsoidal surface will appear perfectly flat at the outer focus. This test is really more delicate than Foucault's center of curvature test, for the reason that conditions are precisely the same as when a star is under observation—which is not true in the other case.

"Any variation of f, p or p', of course, varies the amplifying power slightly, but this is relatively unimportant.

"It took me several hours to line up the optical elements properly, as this is tedious, but only slight adjustments were afterwards necessary.

"I secure the telescope to the saddle by means of leather straps, and take it into the house when not in use. My long focus Newtonian fits into the same saddle."

Figures 1, 2, and 3, show the optical layout and details.

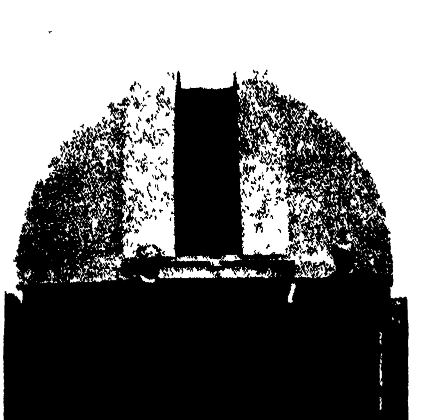


Mr. Decker's drawing of the optical layout and details of his Gregorian

A 9-inch reflecting telescope. The mounting was made by the Rev. John J. Goergen of the Marist Novitiate, Prince Bay, Staten Island, N. Y. and Father McKenna, a fellow-professor at the same institution, with the assistance of two students, as was the observatory below

SO much for Mr. Decker's Gregorian. From another worker who is making a Greg we have received the following comments, suggesting that the Greg is not a suitable job for a beginner (we constantly receive inquiries from beginners who want to tackle one as their maiden job):

"The biggest job about the Gregorian is the mounting. I find that the positions of the Greg mirrors are very critical. Unless they are exactly right, you get blurred images with tails. It is a tough job to line up a system of this sort, and it is highly important that provision be made for adjustment in every direction—lengthwise, crosswise, tilting, and so on— and for locking the parts firmly after they are once set correctly. A Greg is not a job for a beginner —it's a difficult job for any one. The high magnification of the Greg results in a small field, and it is hard to keep objects in view. Jupiter sails across it like an airplane"



The observatory made by Fathers McKenna and Goergen. Its radius is six feet. The roof is made of wainscoating covered with canvas, and revolves on eight two-inch ball bearing casters. The main part of the building is octagonal in shape

THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 271)

"The SCIENTIFIC AMERICAN article suggested fine gage wire chiefly for its low visibility. I do not know the mental process of the fish well enough to know whether this is actually a fact, but it is a fact that this fine wire actually disappears as soon as it strikes the water.

"I expected to have trouble with kinks, but found no such trouble except when landing a fish, which I always do with my hand over the side of the canoe.

"Accurate casting for bass is obviously impractical with this line, but I found that short casting under rapids where the large fish come, supposedly to get an easy meal, is entirely practical.

"An additional important advantage is that this wire line seems to free itself entirely from water when reeled in, which avoids the awful bore of drying silk line

"Having caught lake trout and wall-eyed pike exclusively on this trip, it is evident I was not dealing with fish that swallow the bait. In fact, almost every fish I caught was extremely lightly hooked."

More About Fire Walking

CAN a human being walk barefooted over red-hot stones? A note on this question, published on page 260 of the May number, has brought the following comment from "T.N.S.R." of Madras, India, a medical worker.

"I was an eye-witness to at least two fire-walking ceremonies and was indeed struck by the remarkable freedom from injuries which characterised the ritual. At one of these which I saw at Pallavaram, in the Chingleput District, there were 18 men of ages from 18 to 65, who participated in the ritual. The fire was about 16 feet by 12 feet by 4 feet deep and was made up of huge logs of wood which were allowed to burn for over six hours before the men went into it barefooted and with only a wet loin cloth on their person.

"These men took a bath immediately before they got into the fire, and with the wet loin cloths on their person, freely walked over the red-hot embers, chanting some weird religious songs.

"The only rational—at all events, what appeared to me to be rational—explanation was that these fire-walkers smeared their bodies with the juice of some leaves, which had the remarkable property of desensitizing the skin to fire. Other explanations ascribe the freedom from injury to mystic and occult powers, and to religious fervor in the walkers, which transcended all physical feelings.

"In the second instance 55 men took part in the ceremony but only one was hurt. If the whole thing was a fake, how can we explain this observed fact of one man being injured?

"I honestly feel it is not a stunt. But, at the same time, I cannot for one moment reconcile myself to the idea that fervor, however deep, can save the victim from physiological injury. It must therefore be some sort of cocaine effect that is induced

in the walkers by the previous application for some days or hours or even perhaps minutes, of some powerful juice which, while producing this effect, is not washed away by the bathing to which the walker subjects himself before the assembled audience—apparently to show them that they had nothing on their bodies to protect them from the fire.

"I would like that you invite a free expression of opinion on this matter from your readers over the globe."

Tail of White Rat is Mexican Medicine

WEIRD medical prescriptions that savor of the long-ago are faithfully followed by Zapotec Indians, it appears from an unpublished report by Dr Luis G. Cabrera, formerly of the Mexican Department of Anthropology.

The tail of a white rat placed against the heart will cure St. Vitus' Dance, these Indians of the Monte Alban region believe. Blood of frogs or snakes mixed with lard forms a pomade to stop bleeding. Surgery is unknown among the modern Zapotecs. Broken bones are set in rigid leaves of maguey.

Powdered frog is the remedy for dropsy. River sand is taken for intestinal obstruction. Scorpion bites are treated on the principle that like cures like. To heal the bites, scorpions are mashed up in mezcal, an alcoholic drink which Mexicans also use to prime gasoline stoves when they refuse to burn.

These Indians are innocent of ordinary facts of anatomy, such as circulation of the blood.

Except in cities, Mexico has few doctors. Only in the large towns are there modern drug stores, with druggists who understand modern remedies. Medicine is largely in the hands of native curanderos, and these are no longer skilled as they were in pre-Spanish times, when Indian science was better regulated.

However, in the past few years, state health departments have grown up. The federal government sends trained health squads to scenes of epidemics, and uses the rural schools to instill health propaganda.

The writer just witnessed vaccination of Mixtec Indians against smallpox during the weekly market day in Tlaxiaco, when thousands come in from the hills. Local troops pushed the first unwilling subjects into the tax collector's office where one visiting government doctor and five school teachers made inoculations. The first Indians vaccinated, resentful of their companions who had thus far escaped, caught the others and brought them in themselves. Indians are not afraid of being hurt by vaccination In fact, they are likely to have faith only in treatments which hurt or draw blood.—*Science Service.*

Photoelectric Relay for A. C.

A NEW photoelectric relay, designed to operate on 110 volt 60 cycle A.C., is normally supplied with contacts having 2 amperes, A.C. non-inductive load capacity. A speed of 600 operations per minute can be consistently maintained. The circuit can be so arranged that no plate current is drawn from the amplifier tube except while the light beam is interrupted, thus increasing

the life of the amplifier tube at slow or medium speeds.

G-M Laboratories, Inc., makers of the photoelectric relay, state that it will operate reliably on changes in illumination as small as one foot-candle or less, and when used in conjunction with the proper light source can be operated at distances as great as 90 feet with white light and up to 40 feet with an infra-red invisible beam.

Naval Aircraft

APPROVED by the Navy Department and passed on to the Budget Bureau, a new program calls for naval aircraft construction of upwards of 500 planes. Half of these are intended as replacements and the other as expansion planes. The new aircraft carriers *Enterprise* and *Yorktown* will be taken care of by this program with 108 planes each.

Forest Plantings Trebled

TREE planting in the national forests was nearly trebled last year, the United States Forest Service reports. And the plantings for the calendar year, aggregating 69,215 acres, were well over three times the annual average for the five preceding years.

The regular forces of the Forest Service planted 13,236 acres. Civilian Conservation Corps' plantings amounted to 45,843 acres, and N.I.R.A. planting crews accounted for 10,136. Forest Service crews operated in six of the forest regions. Ninety percent of the C.C.C. plantings were in the Lake States region.

CURRENT BULLETIN BRIEFS

THE PROGRESS OF BRONZE-WELDING describes correct practice for this work, and its advantages in joining the more common metals. *Write to Scientific American, 24 West 40th Street, New York City, for Bulletin 11 B.—3 cents postage.*

ELEMENTARY PLACER MINING IN CALIFORNIA AND NOTES ON THE MILLING OF GOLD ORES. (The April and July 1934 quarterly chapters [combined] of the *California Journal of Mines and Geology.*) This is a bulletin of 200 pages, well illustrated. There is a selected bibliography on both ore milling and placer mining. *State of California, Division of Mines, Ferry Building, San Francisco, Calif.—90 cents, postpaid (remit by money order).*

THE TESTING AND QUALIFICATION OF WELDERS deals with oxy-acetylene welding, the purpose of the booklet being to outline simple tests for measuring the ability of welders. *Write to Scientific American, 24 West 40th Street, New York City, for Bulletin 11 A.—3 cents postage.*

PLANT PROPAGATION is a well-illustrated pamphlet dealing with the methods of propagating fruits and ornamentals such as roses and evergreens. It has been prepared by Dr. H. B. Tukey, and is sent free of charge on application to the *New York State Agricultural Experiment Station, Geneva, N. Y.*

TELLS HOW TREES AND SHRUBS ARE GRAFTED (Circular No. 138, Experiment Station), by Dr. H. B. Tukey, describes each step in cleft, bridge, bark, and side grafting, and bud grafting or "budding" as it is generally called. *New York State Agricultural Experiment Station, Geneva, New York—Gratis.*

ARMAMENT MANUFACTURE AND TRADE (*International Conciliation No. 295*, December, 1933), by Constance Drexel. Several former issues of this periodical have been devoted to this subject, which has been admirably brought down to date by Miss Drexel. *Carnegie Endowment for International Peace. 44 Portland St., Worcester, Mass.—5 cents.*

NEWS · THE STORY OF HOW IT IS GATHERED AND PRINTED. This is the story of the news—an account of that complex and astonishing process which within the span of 24 hours brings the record of events from the far corners of the world to the reader at the breakfast table. It is a story, beautifully illustrated, of a newspaper organization in action. *New York Times Company, 229 West 43rd Street, New York City.—Gratis.*

OVERTONES AND ATMOSPHERES

(*Continued from page* 237)

ard atmosphere. This is less than one-sixteenth part of the vapor pressure of methane boiling at the planet's probable surface temperature of –120 degrees Centigrade, and methane must therefore be a "permanent" or non-condensable constituent of its atmosphere.

On Neptune, the situation may be different. Ten kilometers of methane, with the planet's smaller surface gravity, would exert a pressure of about two-thirds of an atmosphere, corresponding to a boiling point of –160 degrees Centigrade. Dilution of the gas with hydrogen might lower the temperature of cloud formation to –180 degrees.

This is certainly cold enough, but a planet at Neptune's distance, receiving its heat solely from the sun, would have an average temperature of –220 degrees Centigrade. The sunlit side would be somewhat hotter, but would not get up to –200 degrees unless the escape of heat from the surface into space were obstructed. But it is very probable that this happens; for the atmosphere, which absorbs strongly in the visible, must do so far more powerfully in the infra-red, where the principal bands replace their overtones. The influx of heat from the sun to the visible surface is somewhat hindered, but its escape by radiation into space must be much more so, and this, of course, tends to make the surface warmer.

A very similar situation occurs on Jupiter, for which the theoretical temperature (disregarding the effects of atmospheric "blanketing") is –170 degrees, and the actual temperature probably about –120 degrees.

Whether the whole difference for either planet is due to atmospheric influences, or a part of it comes from a slow escape of heat from the interior of the body, is a problem for future investigation.—*Lowell Observatory, Flagstaff, August 30, 1934.*

Books SELECTED BY THE EDITORS

WHAT ABOUT ALCOHOL?

By Emil Bogen, M.D., and Lehmann W. S. Hisey

THIS book is aimed mainly at young people and it is full of scientific facts about alcohol, plainly and clearly stated. Many middle-aged readers will recall certain sticky, stuffy, goody-goody textbooks of physiology largely devoted to the horrors of the Demon Rum, which the law required their schools to use in teaching. This book is an attempt to avoid that kind of extreme fanaticism. —$1.65 postpaid.—*A. G. I.*

THE NEW INTERNATIONAL YEAR BOOK

By Frank H. Vizetelly, L.D., LL.D.

THE events of 1933 will long be studied and frequently referred to by those who have an interest in the world's progress. The New International Year Book is a sure source of factual material and it is interestingly presented. The year of 1933 showed a remarkable progress in evolving sound fundamentals upon which a workable economical system has been based. The editor of the New International Year Book is to be complimented on condensing such a huge mass of material in a compact volume of 856 pages of ample size.—$6.50 postpaid.—*A. A. H.*

FIRST AID FOR THE AILING HOUSE

By Roger B. Whitman

EVERY house owner will find this an invaluable handbook as it tells how to keep a house in good condition at the lowest possible cost. Its practical advice is based on the questions of 6000 home owners who have written to the author's column in *The New York Sun* to ask what to do about household troubles.—$2.15 postpaid.

CREATION'S DOOM

By Desiderius Papp

IN this book, which is an excellent translation from the German, the author has fused into one long drama the various scientific theories of the earth's past, present, and future, finishing with an account of the end of the world according to science. We see the fate of the human race and meet the future rulers of the world—ants. Then comes the end, when the sun becomes a "nova" and the little earth is licked up in the flames like a leaf in a holocaust. This book contains good science all through, is good reading and, in fact, is rather dramatic.—$3.15 postpaid.—*A. G. I.*

HEROES OF THE AIR

By Chelsea Fraser

EITHER as a running story, to be read for entertainment and information, or as a reference book to be used to settle arguments as to "When was such-and-such a flight accomplished?" this book will find an ever-widening group of readers. Now in its twelfth printing, the present edition has been brought up-to-date to the early flights of 1934. After a short chapter on the history of flying, the author plunges directly into a recitation of aviation events from 1919 to 1934. A chronology furnishes an excellent summation of all important flights during that period.—$2.70 postpaid.—*A. P. P.*

MAN'S PLACE AMONG THE ANTHROPOIDS

By W. K. Gregory, Ph.D., Prof. Paleontology, Columbia University

A REFUTATION of the argument, advanced by a small minority of scientists, that man is but distantly related to the anthropoid apes, and a demonstration of his close relationship to the same animals, as believed by the majority. The author's thesis is based on a comparative study of the anatomy of man and apes, and is rather technical in spots though mainly semi-popular.—$2.65 postpaid.—*A. G. I.*

IDENTIFICATION OF THE COMMERCIAL TIMBERS OF THE UNITED STATES

By Harry P. Brown and Alexis J. Panshin

THIS book was written by professors at the New York State College of Forestry, for the use of those dealing in wood, and it is a very solid, businesslike, unromantic treatise and reference book —not a book about the "pretty trees." It tells how to identify commercial woods positively, not by the old earmarks but by a close study of the minute anatomy, with the naked eye and with a ten-power lens. To assist in this method the book contains 274 excellent, large photomicrographs. After close comparison of these with the samples of wood, and with the keys and descriptions in the book, there should no longer be any chance for argument. Thus a sort of "finger print identification" of wood is made possible, and misrepresentation impossible.—$3.20 postpaid.—*A. G. I.*

ATOMIC THEORY AND THE DESCRIPTION OF NATURE

By Niels Bohr

THIS book of 119 pages contains four reprinted papers by the famous originator of the planetary atom concept. These papers were originally published respectively in 1925, 1927, 1929, and 1931. As they have to do with problems of the quantum theory, their implications will be fully graspable to teachers of physics and to those of equal background.—$2.15 postpaid.—*A. G. I.*

BEFORE THE DAWN

By John Taine

MOST persons of scientific leaning, except those who take all things with deadly seriousness, enjoy scientific romances, even though these are not scientifically true or possible. This book is a piece of pure scientific fiction. By means of the "electric analyzer" it proves possible to review the whole geological and historical past as clearly as we see present events. On the stage walk fighting dinosaurs and other monsters of past geologic eras, shown life size by means of television applied to emanations from ancient rocks. The author is professor of mathematics at the California Institute of Technology, a past president of the Mathematical Society of America, and a member of the National Academy of Sciences. Thus this book reveals the serious scientist at play —writing a yarn—and it makes good reading.—$2.15 postpaid.—*A. G. I.*

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New York City

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Foreign Patent Licensing Corporations

A METHOD by which revenues may be obtained by American concerns owning foreign patents was recently developed in connection with the operation of corporations under the Webb-Pomerene Act which permits of combining for export. In more than one instance, groups of U. S. concerns which were in competition in this country nevertheless pooled their foreign patents and licensed the European industry under this pool of patents. This represents a distinctly new departure and may suggest uses by which concerns which are competing in this country, but have mutual interests abroad, may be able to regulate foreign competition, especially in the industrial countries.—*Journal of the Patent Office Society.*

"Vapex" Mark Upheld

IN a recent decision of the United States Patent Office, First Assistant Commissioner Spencer refused to cancel the registration of the trade mark "Vapex," of Thomas Kerfoot & Co., Ltd., of England, issued March 18, 1924, for an inhalent for the relief of cold in the head, notwithstanding the previous adoption and use of the trade marks "Vicks" and "Vaporub" by Vick Chemical Company, of Philadelphia, Pennsylvania, on similar goods.

The ground of the decision is that the petitioner has failed to establish such likelihood of confusion as would warrant the cancellation of respondent's registration. The First Assistant Commissioner noted that considerable evidence had been adduced by the petitioner in an attempt to show not only that confusion was likely, but that it had actually occurred, and held that in view of the entire record such evidence was totally insufficient to overcome the conviction produced by an inspection of the marks themselves that they possessed no deceptive similarity.

"The First Plant Patents"

UNDER the above title a book by Robert Starr Allyn is now available, containing a discussion of the plant patent law and patent office practice. The volume should be of great benefit to any one interested in obtaining a patent on a plant, or in any phase of the legal aspect of protecting a new form of plant by means of a patent.

The book opens with a reproduction of plant patent No. 63, including the illustration (not in color) of the rose which is the subject of the patent, and the two pages of specification. This particular patent is said by the author to be perhaps the most complete and carefully drawn of any. Contained in the volume are abstracts of 84 patents as well as several chapters covering the history of the plant patent bills and law.

Mr. Allyn presents in this little book a well-rounded discussion of the whole situation, covering not only the legal aspects of the actual patents but the effect which the Plant Patent Act of 1930 may have on those for whom it was originally intended to benefit. Since this act is a legislative attempt to recognize the plant breeder as an inventor, the implications and the results may have far-reaching effects in patent office procedure.

The book is very thorough in its systematic arrangement and is provided with a comprehensive table of contents and index.

Patents in India

THE official date of a patent issued in India is the sealing date. A patent cannot be sealed before four months after the publication of the acceptance of the application in the *Gazette of India* and not after eighteen months from date of application.

Patents are in force in British India only, and are granted for sixteen years from date of application, or from priority date under reciprocal agreement with the United Kingdom, etc. Extension may be granted for five years and in some cases for ten years.

Patents of addition are granted for the unexpired term of the original patent.

Opposition may be made to the grant of a patent in four months from date of publication of acceptance of the application.—*Journal of the Patent Office Society.*

"Beaver-Penn" Mark Not Registrable

IN *ex parte* The Freedom Oil Works Company, First Assistant Commissioner Spencer held that the company, of Freedom, Pennsylvania, is not entitled to register, under the Act of 1905, a trademark for lubricating oils consisting of the hyphenated word "Beaver-Penn" together with the representation of a beaver, all within a rectangular border, without disclaimer of the word "Beaver-Penn."

The ground of the decision is that that notation is merely geographical.

In his decision the Assistant Commissioner noted the decision of the Court of Customs and Patent Appeals in in re Plymouth Motor Corporation, and pointed out the difference between the facts there and the facts in this case and said:

"The town of Beaver is located in the western part of Pennsylvania in the region that is justly famous for its production of hydrocarbon oils. Many of the finest lubricating oils are obtained from this vicinity and, indeed, Pennsylvania motor oils have acquired a high reputation in the motor world. That 'Penn' is an abbreviation of the state name of Pennsylvania is clear beyond reasonable contradiction and this obviously holds despite the two communications submitted by the applicant, one from the United States Government Printing Office and one from the Commonwealth of Pennsylvania, Department of State, both to the effect that the proper *official* abbreviation for Pennsylvania is 'Pa.' No matter what the official abbreviation is, the fact remains that any number of members of the public write the abbreviation of 'Penn.' as standing for Pennsylvania. It would accordingly seem that the mark is no more, no less descriptive than Boston, Mass., and it is therefore held that without disclaimer of the word 'Beaver-Penn' registration cannot be obtained."

F. T. C. Stipulations

STIPULATIONS recently announced by the Federal Trade Commission include the following:

National Rabbit Institute

Monroe Green, successor to National Rabbit Institute of Arcadia, Calif., selling courses of instruction in raising and breeding rabbits, asserted that rabbits could be raised for profit. "Earn $1,000 to $5,000 a year," he advertised, alleging that "proved successful methods show you quickly and easily how to make $1 to $3 every hour of spare time." Green agreed to cease advertising that probable earnings of prospective students would be in excess of the average amount earned by competent rabbit raisers devoting their entire time to the business.

Charm Laboratories

Charm Laboratories, Inc., 521 Fifth Avenue, New York City, selling a medicinal herb compound designated "Charm Tea," is said, to have represented as follows: "Reduce with charm tea safely, sensibly, surely." The respondent agrees to cease advertising that its tea is of itself a competent treatment for obesity or excess weight.

Nature Herb Company

The Nature Herb Company, Seattle, advertising a laxative medicine made of roots, barks and herbs designated "Sen-Gen-Ma," agrees to cease labeling its product as a tonic and from representing it as a preventive, a competent treatment or an effective remedy for any of 20 ailments listed including stomach disorders, pneumonia and heart disease.

Schuyler Preparations

George Schwager, trading as Schuyler Proparations, New York City, advertised "Schuy-Tone Tablets" for the treatment of shyness, bashfulness, blushing, stammering, lack of personality and other defects. "Bashfulness is a disease," the respondent advertised; a disease "to be diagnosed as carefully as any other malady." The respondent informs the Commission he has discontinued advertising his commodity and does not intend to resume.

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NINETIETH YEAR • ORSON D. MUNN, Editor

CONTENTS · DECEMBER · 1934

The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN, December, 1934. Vol No 151, No 6, entered at the New York, N Y Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

Policies and Plans

RESPONSIBILITY for settling wagers would not seem to come within the province of a scientific journal, and especially of one which is edited primarily for the business man and manufacturer. Yet wagers are sometimes made on scientific facts and we are sometimes called upon to give the correct answer, whether or not we approve of wagers, *per se*. In our position as the authoritative interpreter of the accomplishments of science and industry, we are considered the *ex officio* mentor of all things that savor in the slightest of science. Dozens of questions come to our desk daily, and on the answer to some of them—which we gladly give—may hinge the fate of some important enterprise.

The first thought, seemingly, of those who know our tradition is to ask SCIENTIFIC AMERICAN. This feeling of dependence is best exemplified by the statement of one correspondent—an investment broker—that "I know that anything you put in your magazine is correct." Naturally proud of that reputation and of our tradition dating from 1845, we keep faith with you by adhering strictly to fact. Obviously this delimits our discussions, keeps out sensationalism and wild and fantastic prophecies. (The thinking reader will see clear-cut and sane predictions of what the future holds in store in every proper evaluation of today's great works.) We find it necessary, moreover, to appraise a new discovery, development, or achievement in such careful fashion that often our discussion of a thing's *true* significance may follow by weeks the newspapers' first glaring headlines and naïve or unblushing distortion of it. The intelligent reader willingly awaits the critical analysis and interpretation of the accomplishments of science and industry for he knows that he will then get a sharper, clearer perspective.

It is SCIENTIFIC AMERICAN's job to answer questions—before they are asked, as a rule. Just now, due to the tremendous social and economic changes that are taking place, a number of questions cry for an answer. These can be given only through a consideration of conflicting opinions. In these pages, therefore, mental stimulants have recently been provided in the form of debates from which the reader can draw his own conclusions.

The business man, the industrialist, the professional man, the farmer, the investor—these would like the answer to questions that are more important in that they pertain strictly to the business in hand. These will be found in an outstanding series of well-rounded-out articles on a wide variety of major industrial subjects, giving the background, significance, present status, and a definite hint of the future—such as does our leading article on Diesels in this issue—that are planned for coming months. These will all give vitally important information to the alert, hard-fighting business man of 1935. And that reminds us that we intended to tell you to:

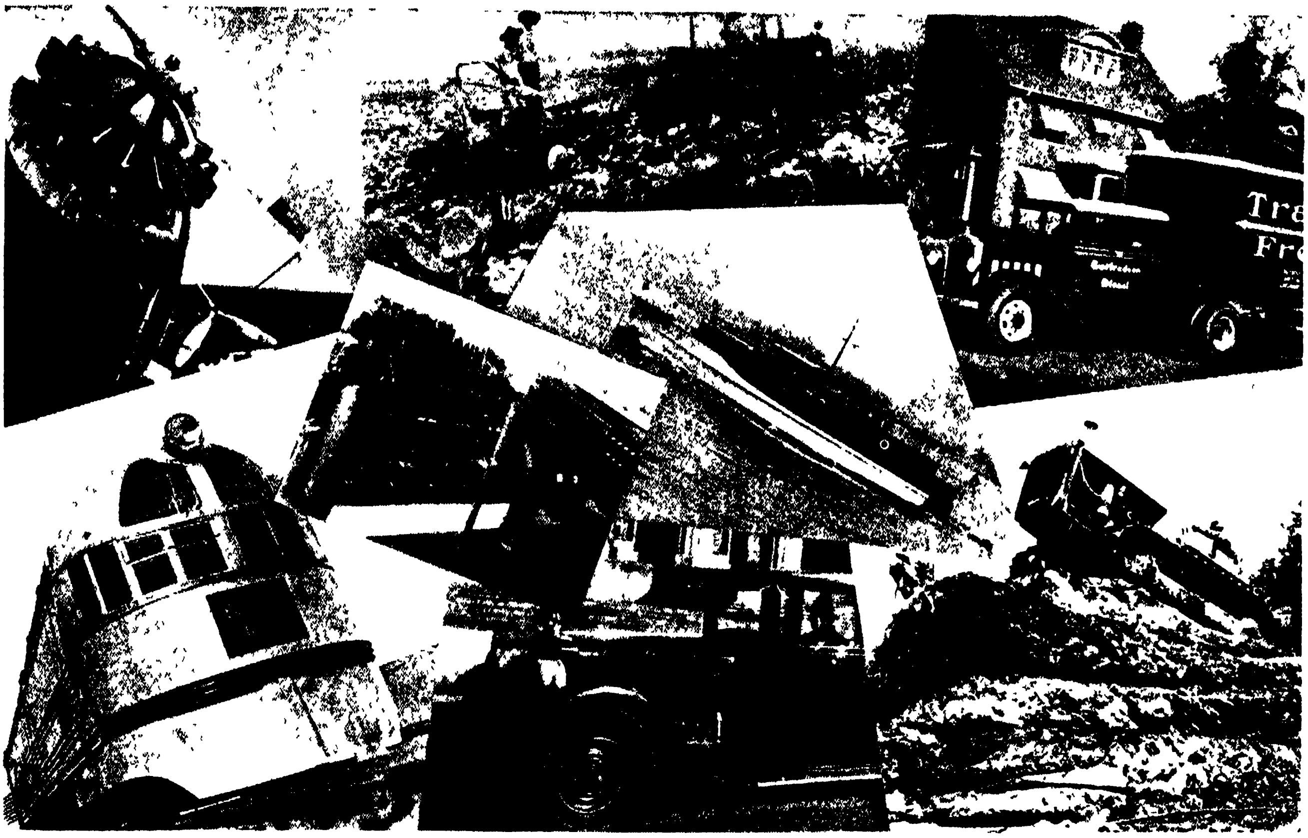
"Look for an important announcement in our next, January, 1935, issue!"

Editor and Publisher

Photograph courtesy The Crosley Radio Corporation

AN ELECTRIC EYE THAT NEVER SLEEPS

AT the base of the 831-foot vertical antenna tower of station WLW is a safety gap which grounds the electrical energy collected from the atmosphere by the mast. When this charge is great enough to jump the gap, a "power follow-up arc" will be formed which will drain off and ground virtually all of the station's 500,000 watts. To prevent this, a photo-cell (see illustration) keeps constant watch over the safety gap and instantly actuates a series of relays when the first arc is formed. These relays shut off the radio transmitter for a split second, effectively preventing the follow-up arc.



DIESEL ENGINES IN INDUSTRY

DIESELS STRIDE AHEAD

Dependable, Economical Motive Force . . . Air, Land, Water . . . Slowly, Surely Advancing in America . . . Great Future Possibilities . . . Saving Not So Much in Cheaper Fuel . . . Decentralization of Industry

By PHILIP H. SMITH

THE Diesel type of engine will become dominant, headlines tell us. News flash following news flash announces astounding performance on land and sea and in the air. A Diesel-powered racing car whirls the 500-mile Indianapolis race at an average speed of 86.14 miles per hour; a giant bus tears from New York to Los Angeles in 91 hours at a total fuel cost of $21.90; the Navy installs a Diesel in its newest submarine; and an airplane so powered covers leagues at a fraction of normal cost.

All these events are fact. The Diesel has been doing astonishing things and has established itself as a dependable, economical motive force. But headlines tell only part of the story. The value of the Diesel as to its future commercial possibilities has to be appraised in less sensational manner. Among engineers there is no unanimity of opinion regarding the Diesel's future, hence the potentialities of this engine will have to be gaged from the rate of progress made—internally, in the perfecting of the engine; externally, in its applications; and, finally, from a consideration of external factors bearing upon its commercial use.

Basically the engine is the same as when invented by Dr. Rudolph Diesel in 1892. It operates on the principle of igniting fuel by the heat of compression as contrasted to the spark ignition of the orthodox gasoline engine. Compressing air to 375 pounds per square inch is adequate to ignite the fuel when it is sprayed into the combustion chamber, but in actual practice much higher pressures are used. More heat is turned into power and less wasted in cooling water and in exhaust gases than with the spark-ignition engine and the advantage of burning low cost fuel and less of it is a very real one.

EARLY Diesels were cumbersome, rough in operation, and odorous, hence first application very naturally took place where these characteristics were no drawback. They were used in the stationary power field for generating electricity, pumping, and so on. Later they came into marine use. In both fields the Diesel has been widely applied, vastly improved, but its performance has not been highly dramatic. The public, being only indirectly concerned with the means of lowering power costs, has paid little attention to the inroads of this engine. Now, with Diesels appearing in trucks, airplanes, and railcars, it is a different matter. These most recent developments are arresting.

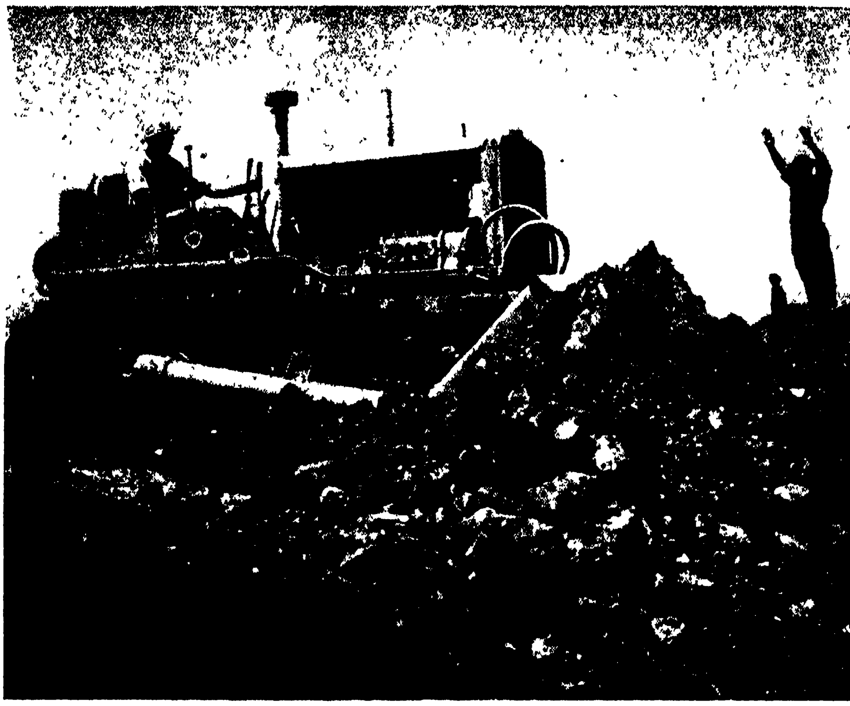
Diesel engine power is now applied in six distinct fields as follows: Stationary power; Marine; Railcar; Trucks, busses, and tractors; Passenger cars; Aircraft.

Before we discuss what the Diesel has done in these various fields and what it may be expected to do in the future, let us look a moment at some cold figures, bearing in mind that we are considering Diesel development in the United States. Progress has been more rapid in Europe due to a variety of reasons, principally the need to offset high fuel costs. In this country, the Diesel is contemporary with the spark-ignition engine, though owing to basic patents, commercialization did not begin until about 1911. This gives 23 years of development against which to measure relative progress.

AT the close of 1933, Diesel horsepower to the approximate amount of 4,650,000 had been sold and of that amount about 95 percent was still in active service. As horsepower goes, this is not a huge amount and the figures serve more to show the reliability of the Diesel than wide adoption. The Census of Manufactures reports 1144 units sold in 1933, these units having a rated horsepower of 139,191 and a value of 4,704,540 dollars. Compare these figures with those of any automobile manufacture and the Diesel industry looks insignificant. The Lincoln division of the Ford business, for example, built nearly twice as many gasoline engines in the same year and the combined horsepower of the output ran over 100,000. Lincoln output is relatively small as automobile production runs, yet the wholesale value of its product was far greater than the value of the Diesel industry's entire output of engines.

Although Diesels are being used for a greater variety of purposes every year, bulk classification of uses remains much the same from year to year. Marine service now accounts for some 20 percent of existing Diesel horsepower, central power stations take 15 percent, the petroleum industry with its oil field and pipe line needs uses 11 percent, and the remaining 54 percent is scattered among industrial users and branches of the Government.

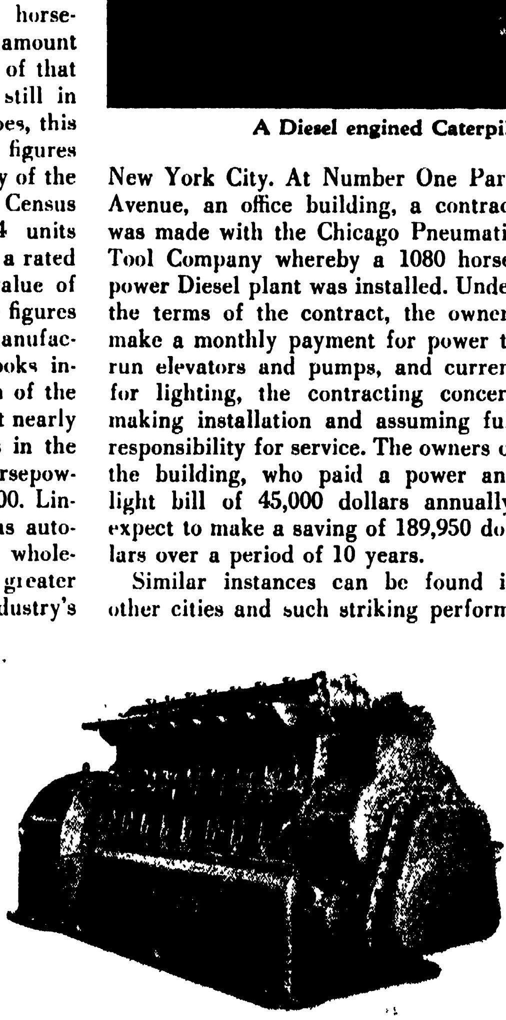
The Diesel has established itself securely in the stationary power field by demonstrating its ability to reduce power costs. In outlying communities it is providing power for industry and even in the heart of metropolitan cities it has made way in the face of supposedly adequate public utility facilities. An instance of this is found in the center of



A Diesel engined Caterpillar makes light of a heavy job

New York City. At Number One Park Avenue, an office building, a contract was made with the Chicago Pneumatic Tool Company whereby a 1080 horsepower Diesel plant was installed. Under the terms of the contract, the owners make a monthly payment for power to run elevators and pumps, and current for lighting, the contracting concern making installation and assuming full responsibility for service. The owners of the building, who paid a power and light bill of 45,000 dollars annually, expect to make a saving of 189,950 dollars over a period of 10 years.

Similar instances can be found in other cities and such striking perform-



Exhaust side of a Diesel-electric unit

ance presages a big future for the Diesel, but performance is not enough upon which to base a forecast. Since costs are the deciding factor for stationary power, the desirability of the Diesel over other power producers must be determined in each instance in the light of oil and coal costs, the amount of steam needed in process work and the local electric energy rate cost. We are likely to see Diesel development make most rapid strides in communities where electric power rates are high, where power must be transmitted long distances, or where a community is too small for an economical steam plant. There is nothing to stop public utilities from making use of Diesels and indeed we find them doing just that where the load factor can be handled best with Diesels alone or Diesels in conjunction with steam plants. Presumably more of this would have taken place had there not been excess utility power capacity in recent years.

Within recent months there have been many Diesel applications in municipal street lighting and water works. Costs are receiving more attention and municipal ownership has been given a boost three ways. First there is the willingness of the Federal Government to give financial assistance to communities wishing to establish their own plants; second, is the refusal of many public utilities to lower their rates; and the third boost comes from the action of state legislatures making possible more liberal funding programs.

SINCE the desirability of Diesel installation by municipalities and small manufacturing concerns hinges in many instances upon existing power costs, the future depends perhaps as much upon the attitude of public utilities as it does upon Diesel technical progress. This we do know—the Diesel is eminently suited as a producer of power and lends itself well to the decentralization of industry, since it provides the small user with the same low cost per horsepower-hour as the large user enjoys. If there is any inherent

advantage in decentralization the Diesel will get the benefit of it and, by being readily available, may hasten the movement in that direction.

Diesels have been installed in every type of seagoing craft from the small privately owned vessel to the large ocean liner. It is a well recognized producer of marine power and a large proportion of the total Diesel horsepower in use goes to sea. It is growing more popular for small craft, but increases for large vessels appear to await a revival of interest in world shipping. Recently the Navy and Coast Guard have been among the most prominent buyers of Diesels, and this governmental use, together with installations in the new German "pocket battleships," is perhaps most responsible for drawing public attention to possibilities in this field.

WHEN it comes to mobile equipment —installation in cars, trucks, railcars, and airplanes—the Diesel steps out into a field where it has yet to win its spurs. It has, however, accomplished feats which have stirred the imagination, created much controversy, and stimulated a vast amount of thoroughgoing research. It is safe to say that where there is so much smoke there must be some fire and what that fire is can best be told by surveying technical progress.

The development of Diesels has been mainly in the direction of cutting weight and raising engine speeds. The low-speed type of Diesel today weighs about 100 pounds per horsepower, whereas 400 pounds was once acceptable. And radically new types have been developed having weights and speeds comparable to their spark-ignition counterparts. For example, the six-cylinder

In a Diesel-electric power plant

Cummins Diesel for trucks and busses, delivering 125 horsepower at 1800 revolutions per minute, has a weight per horsepower of 15.6 pounds, while six-cylinder standard spark-ignition engines for similar use, of comparable horsepower and engine speeds, have a weight per horsepower ranging from 10 to 14.9 pounds.

This newest, fast engine has stimulated great interest among engineers and business men, for reduction of weight and quickening of speed have broadened the commercial horizon. And manufacturers have been prompt to sense the possibilities, hence among the 50-odd Diesel producers, which include such established houses as Fairbanks Morse, Ingersoll-Rand, International Harvester, Waukesha, Winton, and others, there are a score concentrating upon the high-speed type and an equal number adding such models to their line.

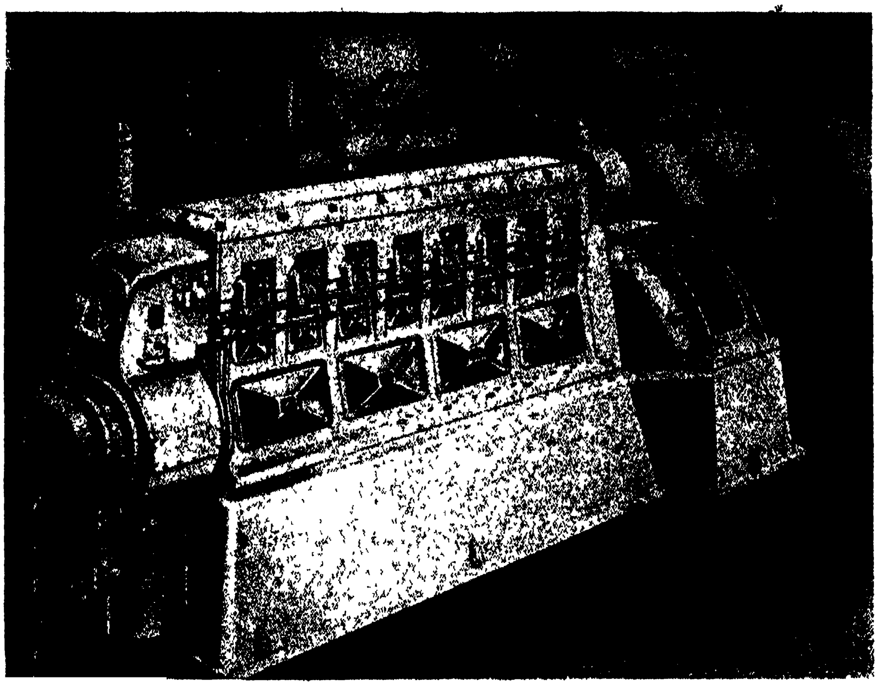
Lumbering operations find wide uses for Diesel engines

There are several types of Diesels being made, but in the main commercial types fall into one of four categories. They are four- or two-cycle and have either air or solid injection. The four-cycle, mechanical-injection type is the most popular and the two-cycle follows closely. Except for the manner in which the fuel is handled there is little fundamental difference from the spark-ignition type engine, but whereas the two-stroke spark-ignition engine has almost disappeared from sight, the two-stroke Diesel is coming in for a great deal of attention. Commercial use of this type is exemplified in the streamline, Diesel-electric propelled passenger train being built for the Boston & Maine R.R. by the E. G. Budd Manufacturing Company, which is to be powered by a Winton two-cycle, 660-horsepower Diesel. This engine will propel three stainless-steel cars, carrying 150 passengers, at a top speed of 115 miles per hour.

The problem which has faced the developer of high-speed Diesels has been complex because operation bases upon the use of slow-burning fuels. To better performance, designers have had to perfect fuel-burning systems which would measure out individual fuel charges, accurately proportioned to the load and in equal amounts to each cylinder, to be injected into the cylinders at just the right time and in such a near-gaseous state as to cause turbulence and complete combustion. That great progress has been made toward a satisfactory solution is evidenced by the performance of today's product.

IN the air-injection type, fuel is blown into the cylinder with a blast of compressed air, while in the solid injection type it is kept in a solid stream up to the point of injection. Variations in method of injection are not uncommon but they all aim at speeding up the combustion process and in the accomplishing of this the Diesel has become a more responsive engine, freer from vibration and smells.

It cannot be said that the Diesel of today can compare with the spark-ignition type of engine in smoothness of operation, speed of acceleration, or quick starting, and this must be weighed before forecasting the replacement of the spark-ignition engine in mobile vehicles, particularly passenger cars. At the same time, progress has been such that it would be foolish to say these handicaps cannot be overcome.



Diesel-electric installation in the streamlined *Zephyr*

It is logical to expect Diesel development where rapid acceleration, vibration, and easy starting are of paramount importance. And this is what we find. High-speed Diesels are going into railcars and meeting with great success. Who has not heard of the Burlington *Zephyr*, for example? This light weight, ultra-modern train, powered with a Winton 660 horsepower Diesel, covered the 1015 miles between Denver and Chicago in a non-stop run of 13 hours, cutting the normal running time in half and making a top speed of 112.5 miles per hour. Authorities predict that Diesels will play a major part in railcar development and that American roads will follow close on the heels of the European where Diesels have become prime movers for new equipment. Charles O. Guernsey, chief engineer of the J. G. Brill Company, builder of railcars, sums up the future of the Diesel as follows:

"THERE is probably no doubt that for high annual mileages where as much as 1000 miles per day may be reached, the Diesel engine will be the cheaper. It can be shown that for low mileages—200 miles per day or more, depending upon the amount of gas tax paid—the gasoline engine gives the cheapest over-all operation. For intermediate conditions, an analysis of each case is required to determine the most suitable equipment. There is no question but that for the larger cars and longer daily mileages, the trend is definitely toward the Diesel."

Another logical field for immediate exploitation is motor truck transport. Here again progress is being made. Within the past two years eight truck manufacturers—Gramm, Indiana, Kenworth, Kleiber, LeMoon, Marmon-Herrington, Sterling, and Ward LaFrance—have added standard Diesel-engined models to supplement their regular lines, and engine makers are offering Diesels for original installation or replacement.

Militating against immediate, widespread adoption of the engine is the fuel situation. Contrary to common belief, Diesels will not digest *any* fuel fed to them. With refinements in detail, they have become more particular about their diet and with the possible exception of kerosene there is no single fuel on the market which will satisfy them all uniformly. Where fuel supply can be maintained, excellent results have been obtained as the following two examples will show:

Pioneer Freight Lines boasts of making the round trip between Portland and Spokane, 800 miles, on 84 gallons of fuel as compared with 190 to 210 gallons of gasoline with a standard truck. The gross weight of truck, trailer, and load was 44,000 pounds, and with a 13-ton payload on the out trip and a 6-ton return load, this outfit maintained an average speed of 25.86 miles per hour. Power was supplied by a 4-cylinder Diesel rated at 100 horsepower. Here, the saving in the cost of a single round trip was 35 dollars.

ANOTHER hauler, Pacific Freight Lines, reports a saving of $51.80 in fuel on a round trip between Los Angeles and Fresno. This line operates 21 Diesels and has ordered 50 more.

These examples bring to the fore a fact of great importance. The Diesel consumes less fuel than the gasoline engine. And this is where the Diesel scores highest. The use of a cheaper fuel means little for the future since the price of Diesel fuel would tend to rise if there were heavy demand. Likewise, the avoidance of gasoline taxes means little for the future since taxes on Diesel fuels can be imposed at the will of legislatures. It is the smaller consumption which promises most for the Diesel and presages wider adoption for motor trucks.

Obviously, until fuel is more readily obtained there can be no overnight switch to Diesel propulsion and likewise fuel will not be standardized and placed on sale throughout the country until there is greater demand for it. Here is a jam which slows the rate of progress. Producers of engines and fuel are getting together, hoping to settle upon a standard for fuel and as this problem irons out the increased call for such fuel will create better sources of supply.

The foregoing indicates that the public is not going to ride around in Diesel-powered passenger cars for some time to come. Having become habituated to sensitive, reliable engines which will beat traffic lights at the slightest touch of the throttle and operate on fuel sold everywhere between these lights, the public has nothing to gain by switching, even if it could.

BEFORE we see Diesels in the hands of the motoring public we are more likely to see them propelling aircraft. While no airplane producer can be found who is pushing Diesel development at present—although Packard has a Diesel airplane engine—much attention is being paid to it by important research groups. The National Advisory Committee for Aeronautics, for example, has been investigating the two-stroke Diesel engine. And the Army and Navy continue to show active interest, because the low fuel consumption would afford wider cruising ranges and definite economic advantages on routes or flights exceeding 500 miles. Another advantage, very real in aviation, is the non-inflammability of the fuel used.

Certainly with the increasing interest in the Diesel and the devoting of more effort to its perfection, its use will grow. In the stationary power and marine field, its place is secure and the advent of the small, lighter-weight, high-speed type is giving a certain mobility to this power source. In railcar and motor truck transportation definite progress has been made but it promises to be some years before Diesels will cut any large figure in passenger cars. Here as in aviation much experimental research remains to be done before the Diesel becomes commercially feasible, but to state categorically at this time that the Diesel cannot dominate ultimately is to deny the experience of the past. There are people living who thought the "horseless buggy" a joke.

OUR POINT OF VIEW

The Death of the Death Ray

DEATH rays we seem to have perennially with us—in the newspapers. Yet there is no known "death ray," at least not in the sense which the sensational headlines and accounts intend to convey. Evidently we are asked to believe every now and then that some new kind of ray, always "diabolical," always "killing," invariably "mysterious," has been hit upon—something to make us shudder about the horror of the wars to be. People must, however, have become pretty well prepared by now to discount these frantic announcements, and most persons of scientific leaning are properly cynical about them.

Oddly enough the newest newspaper death ray really *is* a death ray—but, just to rob it of most of its inherent interest, it is not new. The Smithsonian Institution has given to the press a report of recent researches of its director, Dr. Charles G. Abbot, who has been doing some temperature measurement work on the stars. This is not exactly new work; it is old work done partly in a new way. In the course of its completion it involved that part of the radiation of the stars which is in the far ultraviolet range. These ultra-violet rays are, at least technically, death rays, for ultraviolet radiations shorter than those normally contained in sunlight will kill protoplasm. The sun emits them, as do the stars, but the ozone in the earth's atmosphere entirely absorbs them. Were this ozone suddenly removed life on earth soon would cease to exist. The existence of this protecting gas is sometimes called a miraculous intervention, and sometimes it is said to be a remarkable coincidence that the ozone cuts out just the rays which would kill us. More likely, however, is the fact that protoplasm, from the beginning of evolution on earth, adapted itself to the wavelength of the sun. It would have adapted itself to other wavelengths had these been the ones in the sun's radiation. (Someone once remarked that it must be a Divine intervention that put fine harbors immediately adjacent to the largest cities. There is a possible similarity between the two arguments.)

But the ozone *is* in the earth's atmosphere, and the sun's rays down on its surface where life has its abode do *not* contain any death rays, hence there is not after all any earthly death ray. What the newspapers are doing in using somewhat dramatic headlines ("Death Stars Found; Screen Saves Earth;" "Blue Stars Sending Death Rays; Ozone Turns them from Earth;" and so on) is to give their readers an opportunity to enjoy a slight thrill of horror at a safe distance, a game we all enjoy. It is not a very serious distortion of existing scientific fact. Even the conservative old Smithsonian Institution, in its publicity release, points to the same permissible scare-you-all.

As for real death rays of a man-made nature: In the sense that such rays are asserted to be really potent at distances employable in war, they simply do not exist.

What of the Railroads?

BEFORE long, Congress will convene; and doubtless in his message to that august body of savants the President will outline the "Deal" he desires the railroads to be given. In the meantime—what? The railroads, "trustees" of the life-insurance savings of millions of Americans and of other important funds upon which more millions depend, face a puzzling future. The present uncertainty retards all planning as well as the adoption of constructive measures for salvaging something of the wreckage of years of depression and legal curbs to prosperity.

Are we to have some sort of government ownership? Joseph B. Eastman, Federal Co-ordinator of Railroads, advocates such ownership in principle. He has discussed the railroads' plight with the President, but neither he nor anyone else has given an inkling as to the Administration's leanings or plans. Given either a yea or a nay, the railroads could begin to gather in the loose threads looking toward Congressional action this winter, could go forward hopefully and progressively if government ownership is not intended, or could take steps to protect both themselves and the public and could drop the present complicated plans for further regulation if the experiment is to be tried again. We say "again" advisedly for it must be remembered that it was tried, or was forced upon us, during the World War emergency.

What are the plans for the future of the railroad? They should be announced at once, for all delay is dangerous. It is one thing for the gradually awakening railroads to work toward a great rejuvenation through adoption of the latest scientific discoveries; and quite another if they know that such rejuvenation, so far as their individual enterprise is concerned, is but a dream—a dream for federal bureaucrats to dally with under government control. Aerodynamically designed trains, fast Diesel power, weight saving, stainless steel, welded cars, rebuilt road-beds for 100-mile-an-hour trains—all these are evidences of the vision now inspiring railroad executives but subject to the policies of the government. These, and a considerable amount of necessary railroad reorganization, are in line awaiting the word to go forward strenuously and determinedly or stop for a period of readjustment and modification.

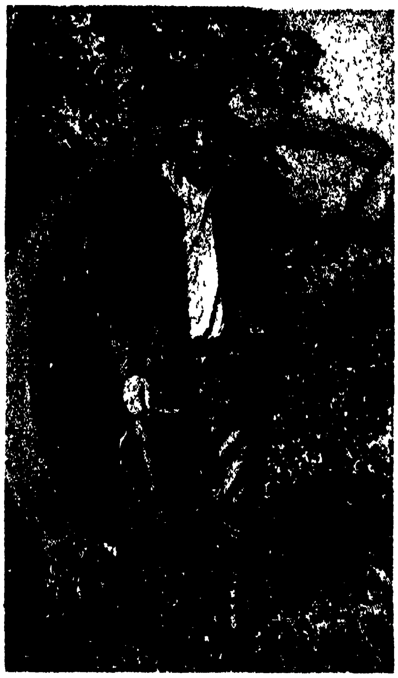
Bootleggers in "Gas"

SOME of the racketeers who built up fortunes during the days of prohibition have turned to other fields. One of the most enticing is the handling of gasoline, as two sources of excess profit are possible. First, they can sell to the public inferior grades of gas under the label of some well-known brand, and second, they can smuggle gasoline from one territory to another, thereby either evading entirely the state and federal taxes, or at least avoiding the payment of part of such levies.

How the tax evasion method of smuggling works out in one instance is essentially as follows: Gasoline for export to another state can be bought tax-free in New York State. A large quantity of fuel is purchased for that alleged purpose. Since there is no adequate check-up system, the gasoline can be taken to another part of the same state and sold to retailers. The sale can be made at a slightly lower figure than in the case of an honest transaction, yet with a four-cent-a-gallon tax to be evaded, the margin of profit remains larger than can be had by an honest dealer.

All this is reflected in the pocketbook of the public. When taxes are evaded, the state and federal incomes from those sources are lowered, and the tax rate is correspondingly raised. Thus is started a vicious circle, because as tax rates are raised, the profit from bootlegging becomes greater, more gasoline is smuggled, less taxes are collected, and the public continues to pay the bill.

One answer to the problem is better law enforcement. Another is a more reasonable and uniform tax rate throughout the country. Make bootlegging of gasoline—or the smuggling of any other commodity—unprofitable, and the illegal operations will be reduced to a satisfactory minimum.



Leonhard Seppala shouldering the tusk of a mammoth, which he found

BEFORE WINTER

By **ELLA WILSON HILL**
Fairbanks, Alaska

WAS Alaska once a semi-tropical land? Excavations going on near Fairbanks, interior Alaska, may answer the question definitely in the near future. An ancient, buried jungle has been brought to view, disclosing large extinct members of the elephant family and other strange animals which played their living, eventful parts presumably thousands of years before man arrived in the New World. The finds prove that ancient Alaska once teemed with species of wild life now extinct, and that a lush vegetation existed.

"But," cautions Otto Geist, archeologist of the Agricultural College and School of Mines, Alaska's higher seat of learning, "scientists have not yet determined why 'some of the finds had long hair."

Sealed in the muck of a few square miles and, curiously enough, segregated into restricted sections or bone pits, there have been unearthed, among other fossils, mammoths, tiny horses' hoofs, super-bison heads in vast numbers, an enormous elk's antler, extinct bears, the rare mastodon, the largest ivory tusk on record, and, to excite the wonder of all, the skull of an African type of lion. The skull was "—distinctly leonine rather than tigrine," writes Childs Frick, well-known paleontologist.

To make the picture of prehistoric Alaska clearer, it may be well to state briefly how these extensive excavations were made possible. The Fairbanks Exploration Company, with its piping system and huge placer miners' "giants," in order to reach bed rock where virgin gold lies, started removing an overburden of brush and solidly frozen muck running in some places to a depth of 200 feet. It was during this stripping process that the workmen commenced to pick up curious bones and fossil ivories. The officers of the gold company at once invited Dr. Charles E. Bunnell, President of the Alaska Agricultural College and School of Mines, to examine the specimens, and he in turn communicated with the American Museum of Natural History in New York. There Childs Frick became interested and investigated the site.

Above: **A mastodon and, *to the right on the facing page,* a mammoth. Both are from paintings made by Charles R. Knight under the direction of Henry Fairfield Osborn. These two related mammals are often confused but were different in many respects which are explained in the text**

How the finds came to be exposed: Stripping off overburden with a "giant"

NO vandalism occurs in Alaska's bone pits; no ruthless ivory looting.

"Here you are, Bone Boys," a mine employee will grin; "take a look at this ante-Adam ensemble." Needless to say, such co-operation goes far toward solving North America's rich prehistory.

The discovery of an almost complete mastodon (Pleistocene) took place at one of the hydraulic placer workings at Chatanika, one morning at five o'clock. A call was sent to Dr. Bunnell, and the "bone men" were sent out without a moment's loss. The remains of this locally rare animal (only a single find

CAME TO ALASKA

Extinct Animals in Warm Prehistoric Alaska . . . Modern Excavations . . . Mastodons and Super-Bisons . . . Monster Tusks . . . Hairy Elephants . . . Reconstructing an Ancient and Spectacular Past

having been reported previously in Alaska) were discovered 50 feet below the surface and 40 feet above bed rock. The fore legs and feet were in an upright position, indicating that this extinct member of the elephant family met his death by sinking into a quagmire.

All of the men in the little town of Chatanika turned out to help. Excitement ran high. This was not just a gold stampede. These cheerful, sweat-streaked, bright-eyed, mud-bedecked pioneers were making history. Every bone, every tooth unearthed, called for a lusty shout. The early morning mastodon find is now listed in a bulletin of the American Museum as a new subspecies, and given the imposing name of *Mastodon americanus alaskensis.*

Leonhard Seppala, Alaska's dog-racing king, who made the "longest and fastest" historic antitoxin race with death, was one of the Chatanika boys who turned out to help save the bones for science. He may be seen in the illustration at the top of the page, leaning against a mammoth's tusk and admiring a super-bison skull found by a friend, though the modest and hardy Norseman made a find of his own—a 200-pound mammoth tusk, as shown in another illustration.

To scientists these gigantic ivory tusks are simply permanent second upper incisor teeth; ivory, just remarkably fine and elastic dentine. Professor Hendricksen and Wilson Walton, archeologists of the College, unearthed an incisor which measured 12 feet 11 inches in curved length, 26 inches in circumference at the base, weighed 295½ pounds, and proved to be by weight the world's largest tusk on record.

There was a marked difference between the mammoth, which thrived in colossal herds in ancient Alaska, and the rarer mastodon. Of the various forms of elephants—the group of mammals with a proboscis or trunk—the mammoth is in many respects the farthest removed from the primitive mastodon-like type. The mastodon is a much older form of life than the mammoth, having appeared in the Miocene Epoch, approximately 15,000,000 years ago, and

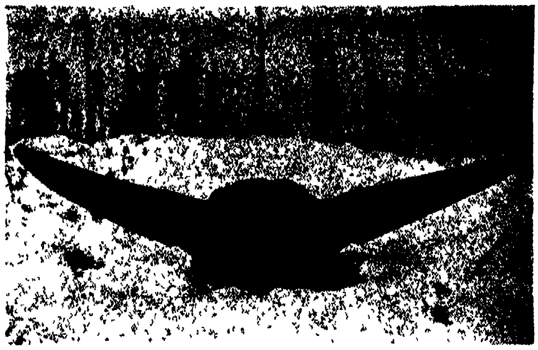
Leonhard Seppala with a mammoth's tusk and super-bison skull

having survived in parts of the earth up to the time when he may have been seen by man. Geologically speaking, the Miocene Epoch came before the Pliocene Epoch, and the Pliocene before the Pleistocene which is synonymous with the glacial epoch and is succeeded by the Holocene, Recent or Human, Period.

PHYSICALLY, also, great differences appear in these two extinct mammals. The mammoth's huge tusks, protruding from his upper jaw, were curved to as much as three fourths of a circle and in very old individual animals they turned inward and even crossed. This rendered them useless as weapons. The mastodon had shorter and relatively straight tusks in the upper jaw, and some species had short tusks about 18 inches long in the lower jaw as well.

From a scientist's point of view the most important difference seems to lie in the molar teeth. The mastodon had teeth with nipple-shaped projections

Left: **Wilson Walton with record mammoth's tusk.** ***Above:*** **Prof. Hendricksen with bones of mammoth**



Skull of a super-bison, spreading twice as wide as the horns of the modern bison, or "buffalo"

and simple roots, the cement in the intervening valleys being atrophied, while the mammoth had long, rooted teeth, flattish on top, reminding one of a child's washboard.

To those who are not especially interested in the nice distinctions of molar teeth, more obvious dissimilarities between these animals would appeal. For example, the mastodon possessed a decidedly receding forehead, while the mammoth was a highbrow in looks, though his forehead was developed not to hold brains, but to inclose the base of his immense tusks, and was mostly bone and sinuses. Even though the mammoth's high brow contained a comparatively small amount of gray matter and an enormous amount of ivory, the massiveness of the skull and its height in front must have given him a kind of scholarly look.

STANDING together (if they ever did), these two extinct mammals must have exhibited a striking contrast. The mastodon was just plain brown, and in size—though not in appearance—compared favorably with the existing Asiatic elephant, the male of which weighs in the neighborhood of three tons and reaches a height of 10 feet. Clothe the circus elephant in an inch thick coat of soft blond or brownish yellow hair and a formidable 20-inch rust-colored mane, insert through his upper jaw and about a yard into his head a pair of 200- to 300-pound incisor teeth, and you have approximated the great mammoths which moved in thundering herds across ancient Alaska and left their huge bones under our feet.

These herds of extinct mammals were herbivorous, which pointed to the fact that prehistoric Alaska was lavish in her supply of foliage. Supporting this theory there was found the lower jaw bone of an aged mammoth, in which the molars had been extruded and the tooth sockets healed over years past, yet the animal lived on. This indicates lush subsistence and a long, comfortable old age.

In a mammoth's molar, worn down to half its size, yet as bulky as a building brick, were found fresh looking pine needles, and caught in the great grinding surface of another molar, still rooted deep in the jaw bone of a mammoth, was some perfectly preserved green grass. Within the same general area and about ten feet beneath the surface were discovered the broken stumps of an ancient forest; and in other parts of Alaska associated with mammoth remains have been found large trees where now the soil is barren and the subsoil frozen throughout the whole year.

Teeth of the mastodon (left) and mammoth (right). The word mastodon means "nipple tooth," the chewing face being made of separate peaks. The animal browsed on leaves and twigs, mammoths ate grass

Strange and spectacular pictures come to view in Alaska's Pleistocene layer of earth. Before the coming of Columbus, horses, which originally evolved in America, were extinct there, but they roamed in ancient Alaska along with mammoths, mastodons, and great bovine herds, super-bisons whose spread of horns reach over twice the size of the American bison or buffalo. Bones belonging to horses large enough to haul a dray, and ponies' hoofs so tiny that one could rest in the palm of a dainty feminine hand, were picked out of the muck. Elk were thought never to have existed in Alaska, but Otto Geist and Peter Kaisen of the American Museum staff unearthed and photographed a single elk's antler measuring nearly five feet in length.

For the first time the great American lion is shown in Alaska's Pleistocene deposits. The skull was not that of a saber-toothed tiger—which, owing to its more northern range, might have been expected. Paleontologists point out that lions, originally of northern origin, may later have followed fat game herds to equatorial regions. Perhaps, they also suggest, the shaggy mane of the African lion, like the wooly forequarters of the bison, are remnants of a former frigid habitat.

TO-DAY truck loads of ancient bones, including "five peck" skulls, are being hauled along the college road at Fairbanks, but in all of Alaska, through deposits of the Pleistocene Epoch, no human bone has been discovered. Alaska's nearly 600,000 square miles seem to have belonged to animals in the restricted sense. Man was evidently not there to discover that the peculiar dentine of the mammoths' and mastodons' incisors had great commercial value. There were no Siberian hunters to covet the "white gold" teeth; no Chinese artists to admire the fine texture and exquisite, pale tint of the ivory. Oblivious to future man, these monsters lived in countless multitudes, played their parts here where moose and caribou are today seen crossing the very college campus, and made their exit, it is estimated, 100,000 years before man.

Skull of a mammoth. The author may be seen at the extreme left, bending over. Next stands Howard Thompson, of the United States Weather Bureau, and below is Captain McClelland, meteorological officer, United States Air Service

n especially for Scientific American by Logan U Reavis

Engineering Projects in the Southwest

THE Colorado River Aqueduct, Boulder Dam, and appurtenant projects have been described in past issues of Scientific American. The above drawing serves to show the geographical relationship between these huge developments and other projects under way in or planned for the Southwest. The data were supplied by the Department of the Interior, Bureau of Reclamation. The shaded portions of the Colorado River Aqueduct indicate the general location of tunnels, of which there will be 46, totaling 85 miles in length. The All-American Canal with its Coachella Branch will supply water to the Imperial and Coachella Valleys and will have a maximum section of 232 feet in width at the water line, 160 feet in width at the bottom, and 20.6 feet in depth. At Pilot Knob, seven miles west of Yuma, also at four drops in level of the canal, there will be opportunity for the development of 60,000 kilowatts of hydroelectric power. Of the 165,000,000 dollars provided for the construction of the entire Boulder Dam project, 38,500,000 dollars is to be allotted to the canal.

COULD A MANNED ROCKET

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

THE study of the heavens touches a surprising number of affairs on earth—matters of fancy as well as of fact. For centuries, writers of romance have made bold from time to time to imagine voyagers leaving our planet and launching out boldly into the depths of space. What they find on their arrival in some other world does not concern the astronomer—except as he may individually enjoy fantastic adventures or social satire. How the imaginary travelers got there, indeed, is more in his line—for which reason he is usually likely to laugh, or groan, according to his temperament, and wish that the author had been less explicit. Too often some physical absurdity obtrudes itself and destroys for the moment, if not for good, the sense that "a tale is true while the telling of it lasts," which is the very life of fiction.

For a few of the best stories the illusion stands the strain, even for the technically informed reader; for example, in Jules Verne's "Voyage from the Earth to the Moon," and above all in that masterpiece among all imaginative romances, "The War of the Worlds." In both of these the voyage is made in great projectiles shot out from some vast gun, and then moving freely through space.

This notion, old as it is, tempts the imagination. There is certainly nothing absurd in the conception—though human ballistics are at present quite inadequate to the task—and the fate of the shell, once fired, can be discussed as a really scientific question. Some of the results are so simple, and yet so far from obvious, that we may be forgiven if, for this once, we turn from real problems to purely imaginary questions.

WHAT would be the best way of firing a projectile to reach another planet—for example, Mars? How should it be aimed? When should it be discharged, and what minimum muzzle velocity would be required to make success possible?

The great obstacles, as everyone knows, are two: the earth's gravitational attraction, and the resistance of the air at the start. For the moment let us forget them both, or a least postpone their consideration, and consider a simplified problem. Suppose that we inhabited, not our large and air-cloaked planet, but a little asteroid pursuing an orbit just like the earth's. Waive the question of how we could keep alive—suppose that we could, and that we had at our disposal resources of present human engineering and gunnery. We would have no air resistance, and the attraction of our little planet would not bother us seriously. What could we hope to hit?

An interesting pair of spectra, not connected with Professor Russell's present article, but reproduced because available at the time. They pertain to the new aluminized or evaporated aluminum mirrors for telescopes, which permit astronomers to photograph the spectrum considerably farther into the ultra-violet than previously. Bottom spectrum reflected from silver mirror, top one from aluminum. Both are shown cut off in middle, at the green (right end). Kindly furnished by Dr. John D. Strong, of the California Institute of Technology, who has been largely responsible for the development of the evaporation process for aluminum and other metals

If we ignore, too, the attraction of the planet which is our target, the problem becomes an easy one, involving only the laws of planetary motion. The formula for calculating the velocity of any body —planet, projectile, or meteorite—moving in an orbit about the sun, is so simple that, with due apologies, it is written here:

$$V^2=C\left(\frac{2}{r}-\frac{1}{a}\right).$$

V is the velocity in the orbit (relative, of course, to the sun); *r* the distance of the body from the sun, and *a* the "mean distance," which is the average of the greatest and least distances in its elliptical orbit; while *C* is a constant. If we take the earth's distance from the sun as a standard for *a* and *r*, and measure our velocities in kilometers per second, $C=866$. For the earth at its average distance, *r* and *a* both equal 1, so $V=29.76$ kilometers per second. In what follows we shall neglect the small eccentricity of the earth's orbit, but Mars has too eccentric an orbit to neglect. His mean distance is 1.524 (the earth's mean distance being taken as unity) while his actual distance ranges from 1.382 at perihelion to 1.664 at aphelion. Our formula shows at once that his orbital velocity is 26.50 kilometers per second in the first case and 21.95 in the second.

If our projectile, after it leaves our asteroid in the earth's track, is moving slower, compared to the sun, its mean distance will be smaller, and most of its orbit (though perhaps not all) will be inside that of the earth. This is a poor way to aim at Mars. We must evidently aim our gun so that the shell will move faster around the sun than the gun itself. The best way to do this is obviously to point it *forward*, directly in the path of our planet's orbital motion. Our projectile will now move in an orbit with a greater mean distance than the earth. When it started it was going at right angles to the sun's direction and at distance 1; hence all the rest of its track will lie outside the earth's orbit, and we are doing better.

As we increase its velocity its orbit will extend farther and farther from the sun (on the side opposite to the point of firing) and at last will get out as far as Mars. We will do best to choose the *nearest* point on Mars' orbit as our target, when we will get the situation shown in the diagram, which is drawn accurately to scale.

The greatest distance of the projectile's orbit from the sun is equal to the least distance of Mars. The mean distance is the average of this and the earth's distance; that is, 1.191. Our formula now shows that, relative to the sun, our projectile has a speed of 31.80 kilometers per second at perihelion (P_0 in diagram). This is pretty high, but it is only 2.04 kilometers per second greater than the earth's velocity. By the simple device of pointing our gun "forward"—that is, to a point on the ecliptic 90 degrees west of the sun—we thus get almost 94 percent of the required speed from the orbital motion, and have to demand only a little over 6 percent from our gun.

REACH MARS?

Had we been so foolish as to shoot in the opposite direction, we would have required a muzzle velocity of 61.56 kilometers per second—or 30 times as great!

Even at best, the minimum velocity of 2040 meters, or 6700 feet, per second, is high enough. But according to such reports as were made public, the gun which, during the World War, bombarded Paris from within the German lines must have had nearly, if not quite, as great power.

If it were not for the earth's gravitation and the resistance of our atmosphere, a slightly improved "Big Bertha," would suffice to bombard Mars!

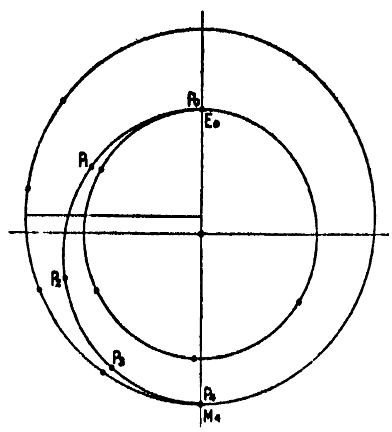
At its aphelion our projectile would have a speed of 23.92 kilometers per second, while that of Mars is 2.58 kilometers greater. Mars would therefore overtake it, and to a Martian it would appear to fall from the heavens ahead of the planet in its orbit.

THE time of flight is readily found by Kepler's third law to be 237 days, or almost eight months. The position of Mars, the earth, and the projectile, at intervals of two months, are shown in the diagram. At first the shell moves faster than the earth, but as it recedes from the sun it slows up, and at the last it is going slower than Mars.

At the time the shot is launched, Mars is nearly in the line of fire, but this would not be the case for a more distant target such as Jupiter. It would be possible to reach any other portion of Mars' orbit by increasing the velocity of the shell. Using a formula once more, it is found that to reach the aphelion of Mars we would require a muzzle velocity of 3.57 kilometers per second. This would make much severer demands on our artillery, but the shell in this case would reach Mars with a relative speed of 1.98 kilometers per second, so that a Martian gunner wishing to reach the earth would do best to shoot backward, at his planet's aphelion, at this speed.

When the gravitation of the earth and of Mars is considered, things look very different. Even in the absence of all air-resistance a velocity of 11.4 kilometers per second would be required to send a projectile from the earth's surface just clear of its attraction. A small increase above this limit would give it energy enough to escape with a good speed; for example, an addition of only 6.18 kilometers would produce the 2.04 kilometers at a distance which we have previously discussed. (This follows at once from the consideration of kinetic energy.) The atmosphere would exert an enormous resistance on so rapidly moving an object, but exact allowance for this would be difficult. Even without it the velocity demanded is far greater than has been attained or seems likely to be attained by any terrestrial device, so that the whole matter remains for the present in the realm of the imagination.

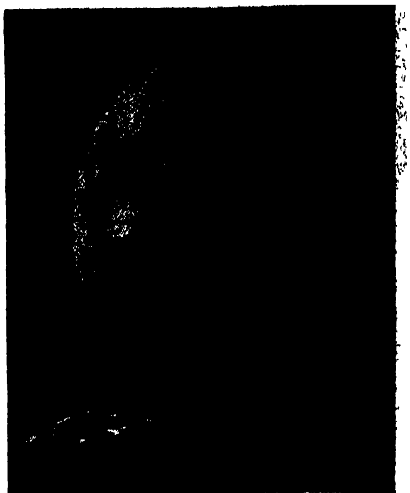
Even if we were back on our asteroid we would have a hard job to hit Mars, for it is a small target at that distance.



Path of a projectile from the earth to Mars, drawn accurately to scale

Even a small change in the muzzle velocity will cause the orbit of the projectile to enlarge, so that P_4 lies outside M_4 in the diagram, and the planet, as it overtakes it, will pass inside without a collision. A very simple application of calculus to our formula shows that a change in the velocity V of one centimeter per second will shift P_4 by 81 kilometers. The diameter of Mars is only 6700 kilometers. If our gun sends off its shell with a speed as much as 18 inches per second too great or too small, it will miss the planet altogether. No such precision, of course, is within the reach of present-day ballistics.

Curiously enough, the accuracy required in the direction of aim is not so exacting. A slight deviation outward at E_0 would cause the projectile's orbit to lie outside the platted track for almost all its course, but it would recross very near P_4, and so would stand a good chance of being hit from behind by Mars. The same would be true of an error in aiming up or down—outside the plane of the ecliptic—provided that



Courtesy American Museum of Natural History

Mars from its inner satellite, as conceived by Howard Russell Butler on the basis of areographical study

Mars too was exactly on this plane. When he was not, serious additional complications would arise, which need be no more than mentioned here.

Any exact calculation of the path would have to take all sorts of things into account—the motion of the gun arising from the earth's rotation, the attractions of the moon and of the planets, and especially that of Mars as the shell came down. It would be an appalling task, even if the initial motion were precisely known.

Mr. Wells, in his great romance, makes a dozen or so shells containing live and very formidable Martians, fall on successive nights within 20 miles of London. The technical skill required to bring this about is certainly superhuman, but the Martians of the story showed plenty of other evidence of that.

It is almost a pity to point out that they could hardly have been fired off alive. To escape from Mars demands a velocity of 5 kilometers per second—to reach the earth, 5.4 kilometers. To get up this speed, even in a gun ten miles long, would demand an average acceleration a hundred times that of terrestrial gravity—which would crush and flatten out anything bigger than an ant, if not a microbe. The shock on hitting the earth would be still worse.

TO offer such arguments as criticism of a great novel would be folly. But there is really no hope at all that living things could be shot through interplanetary space. Rocket ships might imaginably do better, though their success seems very remote. There is no hope, either, that such creatures as we are could survive at all on any of the planets. But, even if some future ship could carry "fuel" for a round trip, its pilot would do well to follow the traffic lanes which have here been sketched.—*Mount Wilson Observatory, Pasadena, California, October* 1, 1934.

How Chemistry

Food Sleuths Stop Flour Spoilage . . . Olives Given Clean Health Bill . . . Chlorine Gas Saves Lives . . . Cautions For Home Canners . . . Truth in Canned Food Labels . . . Constant Vigilance Necessary

PREPARED flour in kitchen cupboards and on grocers' shelves turned brown, took on a rancid taste . . . went bad. Within a few weeks the perplexed manufacturer witnessed his business slipping away, for careful shoppers no longer would buy his attractive packages. In desperation he turned to a chemist.

"Find the trouble," he demanded, "and stop it!"

Professor Arthur R. Maas, a Los Angeles consultant who has trailed many invisible culprits of chemistry to their obscure lairs, smelled the flour. It proved to be rancid, but that was an effect and he was interested in causes. Then one by one he ran down the individual ingredients: powdered milk, flour, baking soda, salt, shortening.

Individually they proved themselves not guilty, but Professor Maas found a trace of copper in the milk. What had happened? When the ingredients entered the package the copper, being a catalytic agent, slowly oxidized the fats in the shortening. In time thousands of packages of the prepared flour became unfit for human consumption.

"Here, as in many foods," Professor Maas told me, "the constituents were harmless. Taken together, however, they permitted a chemical action which spelled trouble. Copper entered the milk from the mixing kettles, a source which the manufacturer had not suspected." The trouble was rectified, and now the product is as pure as man can make it.

This case is only one of many. Bacteria, yeasts, and molds, the three bad boys of chemistry as it relates to food products, march ever forward in their attacks on the nation's supply of food in its many forms.

In the background stands an army of chemists who throw their forces periodically into the counter attack, beating back these one-celled plants which multiply by budding and splitting into smaller plants, and the many-celled branching fungus plants which multiply by spores.

Yesterday olives spread death by carrying to their victims botulinus poison. The responsible bacteria entered the olives from the soil. Tomato puree blossomed with ugly mold, which spread rapidly over its red surface. Canned orange juice contained excessive acid and was too heavy. Innocent chocolate eclairs, though fresh from the ovens, spread disease among thousands.

TODAY, the chemist stands behind the nation's food supply, guarantees its purity. The manufacturer tells you truthfully what is contained within his labels or the majesty of Uncle Sam's food and drug laws and the health departments of various states draw up the heavy artillery to support the chemical brigades.

Behind the shelves of retail stores these scientific sleuths search constantly for chemical wrong-doers. Acting as detectives, prosecuting attorneys, juries, and judges, they sometimes convict whole chemical gangs, while again they fasten their fingers on lone culprits.

In my search for some of America's outstanding, though little known, cases where the chemist saved the health of thousands who otherwise would have eaten products made from spoiled food or foods which had changed in character since manufacture, I found some brilliant examples of super-sleuthing with test tubes and microscopes.

Only in recent years have scientists been able to study the problem of food poisoning intelligently. Now they recognize two general types. The more common—and more deadly—is botulinus poisoning, once erroneously known as ptomaine poisoning. Here the bacteria usually enters the food while it still is in the soil. In the second type the con-

Above: At every step in the preparation of quality brands of canned foods, chemists make tests for purity. Here a laboi tory test is being made to determine t acidity of one brand of canned spina

Left: The microscope reveals the presence of objectionable spores in tomato puree which had developed a mold. With this information, future products may be kept pure and free from the undesirable spores

GUARDS YOUR HEALTH

By ANDREW R. BOONE

Right: Too great a percentage of solids in fruit juice may militate against complete preservation. Professor Maas applies a hydrometer test to canned juice

Below: Testing a prepared flour, which had gone rancid, for the presence of copper. The metal acted as a catalyst and oxidized the fats used for shortening

taminant usually reaches it through animal or human carriers, generally because of inadequate sanitation.

The expression, "ptomaine poison," is now almost obsolete, and ptomaine is perhaps the rarest of food poisons. It comes from the Greek "ptōma" meaning corpse. Medical men agree the term "ptomaine poisoning" should never be used.

One historic case of botulinus poisoning occurred after a score of men and women, some of them famous in national affairs, had gathered around the banquet table of a western host. They ate and drank and made merry—and a week later the city was saddened as several went to their graves, victims of a deadly poison. Within a few weeks an epidemic of botulism swept over the United States carrying scores of people to their deaths. In every case the fatal illnesses were traced to canned olives.

Field agents for the Department of Agriculture's Food and Drug Administration bought samples of every known brand. They soon narrowed the culprits down to two packs, from western plants. So serious had the epidemic become meantime that the olive industry languished. But the deaths may have proved a blessing in disguise. for the cause was found: a toxin-producing anaerobium which entered the olives from the soil.

Preventive steps were quickly taken. The chemist prescribed a simple remedy: sterilization of the vats in which the olives soak before being canned, with a solution of chlorine strong enough to kill the bacteria, and today you may feel free to eat olives without fear of ill results. To make absolutely sure the chlorine does the job, however, chemists periodically slice open olives from the pack and make check tests.

Chlorine gas took thousands of soldiers' lives during the World War, but today it saves lives by killing the microscopic "bugs." These "bugs" are present in all foods, some being harmful, and others good. In the examination of certain canned products, such as tomato puree, the chemist usually can learn from the bacterial count whether the finished product was made from unclean, spoiled, or over-ripe material.

Widely separated cases of botulism prove the necessity for cleanliness both in commercial manufacturing and home cooking. A California man, after an automobile journey, complained of trouble with his eyes, then double vision, and finally loss of speech and inability to swallow. On the fifth day he died. These symptoms are typical of botulism, but where he encountered the cause could not be determined.

Another outbreak resulted in the death of two men. They had eaten liberal portions of homemade chili sauce with abalone steaks. When taken to the laboratory for testing the material was found to be unusually deadly, and chili sauce was added to the growing list of foods which have proved themselves possible conveyors of the botulinus toxin.

"In fact," Professor Maas told me, "we find the heat-resisting spores of bacillus botulinus practically everywhere. Absence of air and presence of food favors the growth of these germs when they become sealed in a jar or can of food which was not properly sterilized at the time of canning."

MANUFACTURERS throw all known safeguards around preparation of foods, which accounts for the rarity of such cases nowadays, but in the home . . . housewives, the California State Board of Health points out, should thoroughly boil all home-canned vegetables and meats for at least 30 minutes before tasting or eating. The board also recommends that when canning these foods they be cooked under steam pressure which will reduce the loss from spoilage as well as prevent illness, or worse.

In less serious forms of poisoning, the "bugs" may enter the food during or after manufacture—usually afterward.

Several school children, teachers, and parents of a western city recently became ill. Chocolate eclairs were suspected. When inquiries were made throughout the city, it was found all

Left: **To insure that dried spinach will be free from injurious properties, it is fumigated in long indoor ovens**

Below: **A sterilized platinum wire probes the interior of an innocent appearing eclair. A culture made from the custard revealed the presence of staphylococci which had made consumers of the delicacy ill**

the eclairs came from the same bakery. When the chemist plunged a sterilized platinum wire into the custard and took a culture he found the eclairs were heavily infested with staphylococcus germs. Several cats, it was learned, had access to the inside rooms of the bakery through a broken screen. Here was the source of contamination—one which was easily checked.

The fight for healthful foods is eternal, and you can be sure Uncle Sam means business in enforcing the food and drug laws. One manufacturer labelled cheap extract of ginger as "liquid medicine in bulk," and shipped it to customers in other states. Government chemists found the stuff contained "jake" poison, and was weak in Pharmacopoeia strength. Two years in prison and a heavy fine were that gentleman's reward.

Another sold an "improved" wine of cod-liver oil, which is bought for its vitamin values. Uncle Sam's inquiry showed vitamins A and D absent. Again the cheating manufacturer paid the penalty.

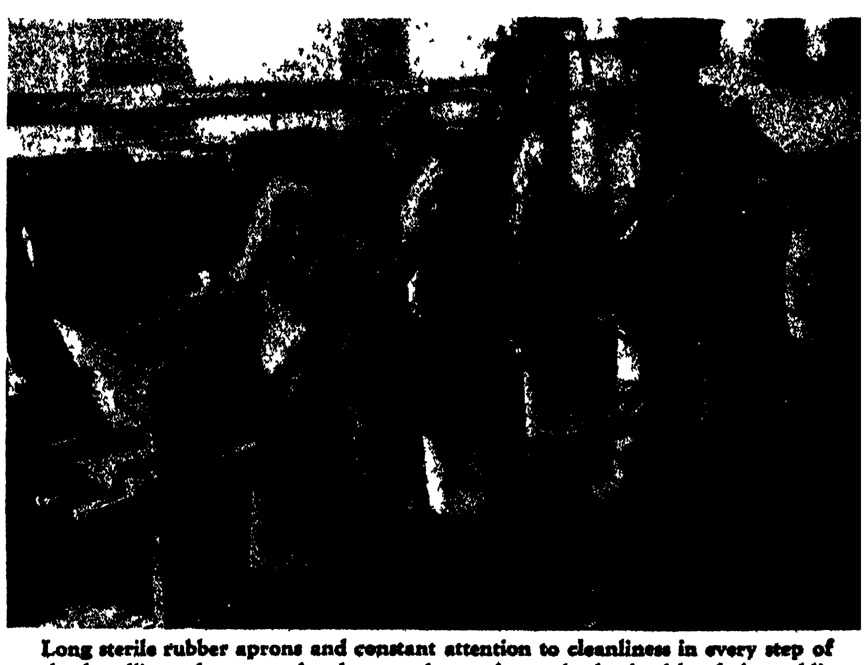
Better magazines, newspapers, and radio stations require that preparations affecting health be submitted for analysis before an advertising campaign is commenced. The government does not censor the advertising or pass on the formula, however. The manufacturer writes his own label, then Uncle Sam checks the product chemically.

Government agents shop constantly for food articles and submit them to federal chemists. Not long ago one of these investigators purchased a can of tomato puree—and found objectionable spores, the result of using defective fruit. This manufacturer unwittingly had violated a "must not" of the law by putting into his product something harmful. Another advertised that a concentrated food contained "all the body-building elements," but no vitamins were found. Both were forced to withdraw their products from grocers' shelves.

SOMETIMES minerals prove very harmful to plants, making the fruit unfit to eat. Thus plants often require water as pure as that which humans need. Black alkali is a destructive substance in irrigation water. One part in a thousand of this caustic slowly poisons the land. White alkali, containing sodium chloride or sodium sulfate, also wreaks havoc on both fruits and vegetables. Dates, figs, oranges, lemons, and all kinds of vegetables are checked constantly to detect the presence of any "blight" or bacteria resulting from such causes.

The chemist identifies the causes of food spoilage through his microscope as easily as he recognizes horses or people, and soon knows whether he is dealing with molds, bacteria, or yeasts.

A producer of canned spinach found his pack acquiring too much acid. Analysis revealed that bacteria were attacking it. Chocolate candy literally exploded. Yeast was doing to it what it does to bread dough—harmful in one case, beneficial in the other. Bread turned ropy, shot through with wild yeasts infesting the air in an otherwise clean plant. Another baker's bread spoiled in the wrappers, molds taking their toll. Bacteria, yeasts, and molds are everywhere, and only constant vigilance keeps the nation's food supply clean and sweet.



Long sterile rubber aprons and constant attention to cleanliness in every step of the handling of oranges by these workers safeguards the health of the public

INFRA-RED AND ULTRA-VIOLET

By ALBERT G. INGALLS

THERE are several strictly utilitarian uses for infra-red and ultra-violet photography. With the former, distant landscapes may be photographed through a haze that renders them wholly invisible to the eye, or the worker may go a-sleuthing and photograph doubtful documents; with the latter there are fluorescence photography, astronomical photography, and photomicrography for extreme magnification. With both methods photographs may be made in the dark.

Most of the utilitarian purposes are largely professional, which means no more than that the intelligent amateur can learn to use them fully as capably as the professional does. But as a starter, the majority of readers are likely to try something simple, and will do it just for fun. This may be what we are living for, anyway, hence no apology is needed for it. So we shall try taking an infra-red photograph in the dark, and later we shall try an ultra-violet picture, equally in the dark. The latter is not difficult but is considerably more complicated than the former.

Infra-red photograph. Total darkness. Tungsten lamps with filters

Obtain some Eastman infra-red sensitive plates, Type 1-R, to fit your own camera. No special camera or apparatus is required. Stand an electric flatiron on end and turn on the current, set the diaphragm at *f*.4.5, entirely darken the room, and open the shutter. Expose for five or ten minutes—longer if a smaller stop is necessary. Develop the picture.

You knew in advance that it was possible to do it, but there is quite an unexpected kick, is there not, in discovering that it will really perform for you as well as for the professional?

The next stunt may be indirect infra-red photography. Set up one or two hot flatirons facing some object and expose much longer—say an hour at *f*.4.5. You may have to make a few trials before you work out the correct exposure time with the set-up you are using.

You may, of course, do both of these things with other heat sources: a hot iron or hot plate or a Sunbowl lamp, but with none of them heated enough to glow visibly if you want to be able to say you did it in the dark.

Suppose you next try photographing a group of persons, or one person, in the dark. Here the source of radiation is preferably common tungsten filament lamps, a lot of them—about 1000 watts per hundred square feet of floor space. To do it in darkness, however, will require a filter to stop all the visible rays. Use Wratten No. 87 filters over all of the lamps. Exposure: Try one second at *f*.3.5, which would mean two seconds at *f*.4.5, and so on in proportion to size of opening available. This stunt is more difficult to set up than the others, but is more fun. At a party, for example, you photograph everyone in total darkness, or elsewhere you may try a bit of Sherlocking—if you can find a way to make the persons you are sleuthing stand or sit or remain still.

PERHAPS next, try infra-red photography out of doors. You must first exclude all the visible light from the plate or it will not be infra-red photography. A Wratten filter No. 25 will be suitable for this, or else a Tricolor Red, or an *A* filter. You will have to experiment again and feel your way, but a first trial may be at 1/50 to 1/5 second with stop *f*.4.5. As you ordinarily will try this in bright sunlight, 1/10 second may prove to be about right. Focus in the normal way. Develop as for panchromatics.

The landscape, as photographed, will seem weird and spooky and unreal. The sky will photograph black because it is relatively lacking for rays which affect plates made for the red end of the spectrum. Leaves of vegetation will be white because they reflect infra-red wavelengths much better than visible ones. Shadows will be deep.

By the time you have practiced with a few of these stunts you will feel a lot like an advanced amateur photographer, and may want to perfect your skill as far as this is possible. Special developer formulas, hypersensitizers and so on, are available for such workers, but one can do most of the things described without more trouble than that required to buy special plates and a special filter.

Ultra-violet photography is not so sim-

A bust, photographed in radiation from two hot but invisible irons

ple as infra-red work. There are two methods: (1) In the "reflected" method use a mercury arc lamp covered with a filter (Ultra No. 586, Corning Glass Works, Corning, N. Y.), ordinary camera, and Eastman 33 plates, and expose about one minute at *f*16. (2) In the "fluorescent" method use same lamp and same filter. Cover camera lens with Corning Noviol O, No. 306, 4-millimeter filter, optically surfaced. Use Wratten panchromatic process plates and expose 20 minutes at *f*.4.5 when 20 inches from object. This method is the one used in deciphering altered documents. It actually does its work in visible, though faint, light; that is, in fluorescent light, which is ultra-violet radiation with its wavelength transformed (lengthened) until visible, by the substance of the object.

Most of the above data on ultra-violet work are included merely to give a rough idea, and the worker will doubtless require some study of detailed sources of information. He will also require patience, a good temper and a better lined purse than infra-red photography will ask of him.

NEAR ABSOLUTE ZERO

IN the Quest of the Absolute or Real Zero Temperature, Known to be 273 Degrees Centigrade or 459 Degrees Fahrenheit Below Our More Familiar "Zero," Scientists Have Now Come Within One-Twentieth of a Degree of Their Long-Sought Goal

By J. G. CROWTHER
London
Author of "An Outline of the Universe," "Science For You," "The Progress in Science" and other books

DURING the last 12 months two first class advances in low temperature physics have been made. Professor Peter Kapitza, the director of the Royal Society Mond Laboratory at Cambridge in England, has succeeded in constructing a new type of machine for liquefying helium. His machine makes the preparation of relatively large quantities of liquid helium much easier and cheaper than before, so that large quantities of liquid helium will soon be within reach of anyone who constructs a replica of this machine.

The other first class advance has been made by Professor W. J. de Haas of the University of Leyden, Holland, who has made experiments in which temperatures within one-twentieth of a degree of absolute zero have been reached. The lowest temperature reached by earlier methods was Keesom's seven-tenths of a degree above absolute zero. The measure of de Haas' remarkable advance is given by the consideration that seven-tenths of a degree is 14 times as high a temperature as one-twentieth of a degree above absolute zero. The measure is given, not by the difference but by the division of the two temperatures. Another illustration can be made by comparing the effect with a similar fall in another part of the scale of temperature. In the attempts made by Faraday to liquefy oxygen 90 years ago, the lowest temperatures reached were about 168 degrees on the absolute scale, or about 100 degrees Centigrade below the freezing point of water. Fifty years later, scientists had produced temperatures of about 12 degrees above absolute zero, a limit about 14 times lower than Faraday's. Keesom's minimum of 0.7 degrees absolute was reached in 1929. Hence after five years de Haas has pushed the lower limit of temperature down the scale through a drop comparable with the drop achieved by his predecessors after 50 years of research.

What is the practical value of research at very low temperatures? The consequences of it in the future will almost certainly be very great. The industrial and military importance of processes conducted at the temperature of liquid air is already large. The use

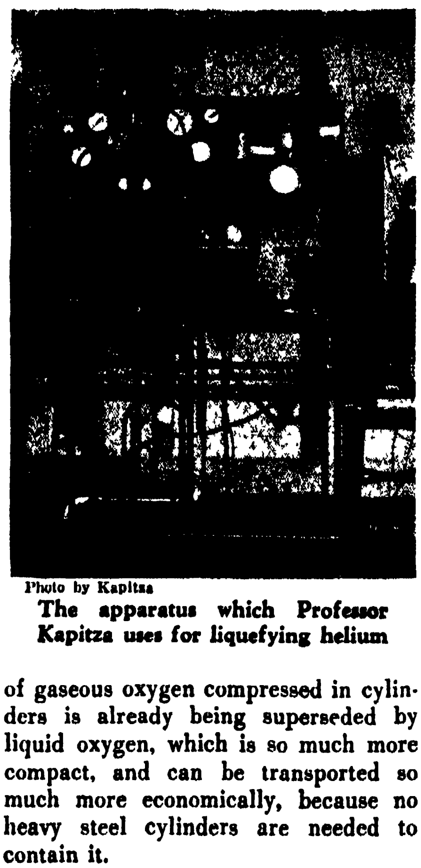


Photo by Kapitza

The apparatus which Professor Kapitza uses for liquefying helium

of gaseous oxygen compressed in cylinders is already being superseded by liquid oxygen, which is so much more compact, and can be transported so much more economically, because no heavy steel cylinders are needed to contain it.

The separation of gases by boiling at low temperatures is already used on a vast scale in the manufacture of various industrial products and explosives.

But the great applications of the future will probably be connected with the phenomenon of super-conductivity. When various substances are exposed to a very low temperature, their resistance to electricity suddenly disappears. Research may discover how to produce perfect electrical conductors at relatively high temperatures, say at the temperature of liquid air. What would happen to electrical engineering if perfect conductors could be preserved by a product such as liquid air, which could easily be provided in vast quantities? Shall we have non-resistant cables, filled, not with metals, but with some peculiar salt, and surrounded by a pipe containing liquid air? When humanity has gained control over natural phenomena between 0 degrees and 10 degrees absolute, it will probably conduct in that region a large part of its productive activities.

BEFORE giving an indication of the chief methods of obtaining very low temperatures, some features of Kapitza's apparatus may be described. As the photograph at the left shows, his apparatus is quite compact. It is very much smaller than the complicated apparatus and heavy machinery previously necessary for the production of relatively large quantities of liquid helium. The practical differences between large and small quantities of liquid helium may be appreciated when it is explained that some of the expert research workers whose work is only possible through the use of liquid helium, have never in their lives seen liquid helium. This is because in all of their experiments they had produced the liquid helium within metal tubes, through which it was not visible to the eye. Their knowledge of the existence of liquid helium in the tubes depended entirely on their observation of its effects, not of itself. One of the advantages of the preparation of liquid helium in relatively large quantities is that it can be handled in glass apparatus which allows direct optical observation of its effects.

After the preliminary cooling of the helium gas to the temperature of liquid nitrogen, Kapitza's apparatus will after 25 minutes' working begin to liquefy helium at the rate of two liters, or about two quarts, per hour. About one and a half liters of liquid air are consumed during the preparation of each liter of liquid helium. This is a minimum performance, and in the future the rate of production will be very much increased. But even this performance compares

very favorably with the original method of preparing liquid helium, which, according to Meissner, requires the consumption of five liters of liquid hydrogen in addition to six liters of liquid air for the production of one liter of liquid helium.

What is the principle of Kapitza's apparatus? It is the invention of a reciprocating engine which will work at any temperature down to absolute zero. Hitherto, no reciprocating engine has been made which will work at a temperature lower than that of liquid air, which is about 100 degrees above absolute zero.

THE difficulty of making a reciprocating engine work at low temperatures is familiar. Everyone knows that in cold weather the pistons stick in the cylinders of automobile engines, owing to the thickening of lubricating oil. At very low temperatures the difficulty of preventing a reciprocating engine from freezing increases enormously. Claude very ingeniously made a reciprocating engine work at the temperature of liquid air by using liquid air as a lubricant. But the same dodge won't work with hydrogen and helium. Hence there appeared to be no possibility of constructing a reciprocating engine which would work at temperatures lower than that of liquid air, that is about 100 degrees above absolute zero. Kapitza has accomplished the almost magical achievement of making a reciprocating liquefier that will work without needing lubrication. The solution is, of course, like so many remarkable inventions, fantastically simple. The nature of the device will be described, after it has been explained why liquefiers whose action depends on the use of a reciprocating mechanism are so superior, when the difficulties of making them work at very low temperatures can be overcome.

The cooling and liquefaction of gases is done by the exploitation of two entirely different principles. The nature of these two principles may be illustrated by the consideration of the properties of gases. A gas consists of a multitude of molecules flying about at a high speed. The molecules of the ordinary air in rooms fly about at an average speed of 500 yards a second. The energy of a moving particle is proportional to the square of its speed. Now the energy of motion of molecules is the same thing as their heat, hence the measure of their heat—that is, their temperature—must be proportional to the square of their speed; or, in other words, their speed is proportional to the square root of the absolute temperature. At absolute zero they have no heat energy, and therefore no speed of motion. Hence the reduction of the temperature of a gas *means* the reduction of the average speed of its flying molecules and can be accomplished directly by this reduction.

How can the speed of motion of the molecules of a gas be reduced? One effective way is by putting heavy movable obstacles in their path. They can bump into the obstacles and transfer to them some of their energy of motion. Convenient obstacles for taking the speed out of swiftly moving molecules of gas are the blades of a turbine or the piston of a reciprocating engine. As the bombarding molecules lose their speed the turbine wheel or the fly wheel gains speed. Hence the size of the increase of speed of rotation of the fly wheel is a measure of the amount of speed—that is, the amount of heat—which has been taken out of the molecules of the gas that have passed through the engine.

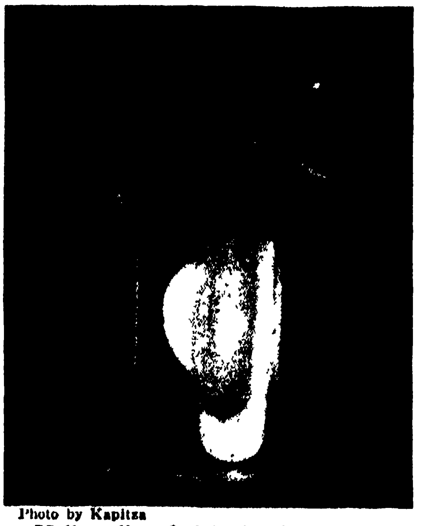


Photo by Kapitza

Helium liquefied by Prof. Kapitza. It looks hot, but is 450° below zero

Suppose you have a very large tank containing a vacuum, and fitted with a large tap. If you suddenly open the tap, air will rush in. As the molecules of the in-rushing air will meet with no sensible resistance (until sufficient air has collected in the tank to begin to offer a noticeable back pressure) their speed will not be decreased, and hence the temperature of the in-rushing gas will not be reduced in spite of the fall of pressure. If an engine were fixed on the tap, so that the air would have to pass through and make the fly wheel speed up before it could get into the vacuum, then the molecules that reached the vacuum would have given up and lost some of their speed to the fly wheel, and hence some of their temperature.

The method of cooling a gas by allowing its molecules to give their speed to a movable piston or wheel is very effective. Everyone has seen how a billiard ball which has been aimed at a stationary ball loses speed after impact, and how the struck ball goes off with some of the speed of the striking ball. Hence one can imagine that if a swiftly moving molecule of gas impinges on a suitable sort of movable obstacle, it may be reduced almost to rest, and the movable obstacle will go shooting forward with the energy of motion it has gained from the molecule. But the molecule, having been reduced almost to rest, its temperature must therefore also have been reduced almost to absolute zero.

Since the impact of gas molecules on movable objects such as pistons connected with fly wheels can effect very large reductions in the average speed of the molecules, the method of cooling by expansion through engines is very efficient.

BEFORE a gas can be cooled by expansion it must be at a higher pressure than that existing in the chamber into which it is to be allowed to expand. So in practice gases must be compressed to a pressure above the atmospheric before they can be cooled by expansion. The compressing requires work to be done. But as the expansion-against-movable-objects-such-as-pistons method of cooling is very effective, a considerable part of the work done by the compressor is gained by the fly wheel of the expansion engine. Hence the expansion engine method of cooling allows a fair part of the work done by the compressor to be used for taking heat out of the gas which is being operated upon.

Compressors have to be driven by electric motors or oil engines. The user has to spend money on the electricity or oil, so he wants the maximum amount of cooling to be done for the minimum expenditure on fuel.

While the expansion engine is theoretically very efficient, it is very difficult to operate at low temperatures. As already mentioned, the pistons freeze up, owing to the lack of lubricants effective at low temperatures. Also the metal of the reciprocating parts tends to become brittle at low temperatures. If the machine is not designed and constructed with great attention to the properties of its materials, it flies to bits through brittleness when it is run at a low temperature. Hence, until Kapitza invented his special form of expansion engine, the method of cooling a gas by making its molecules give their energy to a piston could not be used for obtaining very low temperatures, and no advantage could be derived from the high theoretical efficiency of the method.

So, until recently, low temperatures have been obtained mainly by the exploitation of an entirely different principle. Gases such as air are not "perfect." That is, their molecules are not entirely without effect on each other; they have a slight mutual attraction. When the average distance between the molecules of a gas is increased, a little energy has to be consumed in forcing them farther apart against this slight

mutual attraction. This energy is taken from the energy of motion, or heat, of the molecules of the gas. The slight fall in temperature of a gas when the average distance between its molecules is increased, was discovered by Joule and Thomson over 80 years ago. As this cooling effect is due merely to the increase in the average distance between the molecules, and not to the bumping of the molecules against a piston or any other movable object, cooling machines based on the application of the Joule-Thomson effect can be constructed without any moving parts, so that no lubrication problems or serious difficulties owing to the brittleness of reciprocating parts need arise.

In cooling machines operating on the Joule-Thomson effect, the gas to be cooled is compressed to a high pressure, and the heat produced by the compression is taken out by a cold water circulating system. The gas, now at high pressure and room temperature, is allowed to expand through a fine nozzle. Owing to the increase in the average distance between the molecules after they have passed through the nozzle, the issuing gas is cooled slightly. The slightly cooled gas is sent around the tube conducting the fresh lot of compressed gas to the nozzle, so that the fresh lot of gas is slightly cooler than the room temperature when it reaches the nozzle. After expansion through the nozzle its temperature drops, owing to the Joule-Thomson effect, but to a slightly lower temperature than the first lot of expanded air, because it started to expand at a slightly lower initial temperature. This system of employing the last lot of cooled gas to pre-cool the oncoming lot of high pressure gas is named the regenerative system of cooling. By it the temperature is steadily reduced as more and more gas is forced through the nozzle.

As the Joule-Thomson effect produces such a slight fall in temperature for a big fall in pressure, a great deal of compressor pumping must be done to achieve a substantial fall of temperature. Hence a large amount of fuel must be consumed in order to produce a useful fall of temperature. Cooling machines operating on the Joule-Thomson effect are therefore, in the scientific sense of the term, very inefficient. They consume much power in producing a small fall of temperature. Meissner has calculated that the liquefaction of helium by the application of the Joule-Thomson effect must theoretically consume about 100 times as much power as liquefaction by an expansion engine which succeeds in directly transforming the energy of the moving helium molecules into mechanical energy.

But at low temperatures the cooling efficiency of the Joule-Thomson effect increases considerably in comparison with that of expansion engines. The magnitude of the slight attractive force between the molecules of a gas increases slightly with the fall of temperature. Hence the Joule-Thomson cooling becomes rather more effective at low temperatures. But the cooling by an expansion engine becomes less effective at low temperatures. As already mentioned, the speed of the molecules of a gas is proportional to the square root of its temperature. A reduction of ten per cent in the speed of the molecules of air

The low temperature laboratory at Kharkov, mentioned in the article

at room temperature, that is at 289 degrees absolute, produces a fall of about 50 degrees, but a reduction of ten percent in the speed of the molecules in air at -100 degrees Centigrade, or 173 degrees absolute, produces a fall of about 30 degrees only.

Hence the most efficient method of liquefying gases that condense at very low temperatures is to cool the gases down to within 10 degrees of absolute zero with an expansion engine which makes the gas molecules do work, and then produce the further cooling by increasing their mutual separation through the use of the Joule-Thomson effect. This is the plan that Kapitza follows.

How does he make his reciprocating expansion engine work within ten degrees of absolute zero, when no one before has made one work within 100 degrees of absolute zero? He solves the problem of lubricating the piston by avoiding the necessity for lubrication. He deliberately arranges that there should be a clearance between the piston and the walls of the cylinder, so that they are not in contact, and lubrication is unnecessary. But how can a leaking piston take energy out of the gas? Kapitza arranges that the piston moves very rapidly on the expansion stroke, so that the expansion is completed before much gas has been able to leak past.

This engineering device is characteristic of Kapitza's genius, and reminds one of the device by which he produced magnetic fields of 300,000 gauss by short-circuiting a dynamo through a solenoid. In both cases, he has produced effects outside the ordinary range of mechanics by evading the limitations of the ordinary ranges of working velocities.

He is now about to combine his two powers of very intense magnetic fields with very low temperatures, in an attack on the fundamental atomic properties of matter. Whatever he discovers, he will enter a region of investigation that has hitherto been closed to man.

For the production of small quantities of liquid helium the method of F. Simon has been of great value. He showed how liquid helium could be obtained by an expansion of highly compressed helium gas. His apparatus is in principle an expansion engine that makes one stroke only, and therefore avoids the engineering difficulties presented by reciprocation at very low temperatures. By working with small quantities of material many important experiments can be made with small quantities of liquid helium. Simon's apparatus is simple and inexpensive and has been used with great success in low temperature investigation by himself and K. Mendelssohn at Oxford, and by M. Ruheman at Kharkov in Russia.

The method used by de Haas for producing extremely low temperatures depends on a phenomenon first pointed out by Langevin in 1905, who remarked that when magnetized oxygen is demagnetized, its temperature should be reduced. In 1927 W. F. Giauque again pointed out that the demagnetization of a magnetized body should produce a fall in temperature, and afterward with Clark employed the method experimentally. In 1926 Debye independently calculated the size of the fall of temperature to be expected in gladolinium sulfate when it is demagnetized. The calculation depends on the conception of a magnetizable body as a collection of a great number of very small magnets. When such a body is not magnetized, the little magnets are pointing in random directions. The act of magnetizing removes this random arrangement and alines all of the little magnets in a certain direction. Hence a magnetized body is in an ordered state. By recondite thermodynamic considerations it can be shown that if the ordered magnetized system is destroyed, energy is absorbed from the heat motions of the molecules, and the temperature of the body decreases.

Courtesy The Illustrated London News

w of the huge *Queen Mary* r construction at Clydebank

The *Queen Mary*, known only as *Number 534* during her construction, showing, in the backgr yond the Clyde River, the River Cart which had to be widened and dredged to permit launching

'QUEEN MARY'

NOTWITHSTANDING widespread opposition to the construction of huge transatlantic liners, the British have deemed it worthwhile to finish and launch the giant Cunarder *Queen Mary*, which within 18 months or so will make her bid for the mythical "blue ribbon" of the Atlantic. Shrouded in deep secrecy during the construction period, exact details of the ship have been unattainable. The drawings reproduced above were prepared by Frank H. Mason, the only artist allowed access to the ship before her launching. Construction of the ship was started several years ago, only to be stopped by labor troubles in November 1931. Work was not started again until last December and the ship was finally launched in September 1934. The actual launching operations were extremely delicate, due to the tremendous bulk of the ship, but the River Cart provided the necessary space, as shown above. As the ship became water-borne, massive drag chains took up the strain and checked her momentum. The *Queen Mary* had a launching weight of 34,000 tons, nearly 10,000 more than the *Aquitania*, and will have a gross tonnage of 73,000. She is 1018 feet long with a 115-foot beam, will tower 234 feet from keel to masthead, and will have an estimated speed of 32 to 35 knots. For comparison of size: *Leviathan*—48,943 registered tons, 907½ feet long, 100¼ feet beam. *Majestic*—56,621 registered tons, 915 feet long, 100 feet beam.

THE AMATEUR AND HIS MICROSCOPE—XIII

Plants that Swim

By KEN G. NIBLACK
Bausch and Lomb Optical Company

THE riddle of early microscopists—the diatoms—is exactly as fascinating, if not as mysterious, in 1934 as it was in 1834. These forms of life swim about like animals or fish, yet their life chemistry is like that of plants! Are they animals or plants?

It was a plunge into the calm waters of a woodland lake that stirred my first curious interest in these odd denizens of

On the under side of a glass, some scum from top mud of a small lake

the aquatic world. Muddy brown water ruined the refreshing bath I had counted on. What is this shiny stuff in small lakes that gets into the eyes, ears, nose and mouth, but is rarely encountered in large, or swiftly moving, bodies of water.

Enthusiasm about microscopy prompted me to dig up about a pint of bottom matter from a small lake, so that I might compare it with the bottom matter of Lake Ontario and learn why there was such a marked difference. I knew, of course, that in the large lakes I was dealing principally with mineral matter, and in the smaller, quiet lakes with vegetable and animal matter. I determined to learn their true nature under the microscope. This is how I went about it:

I permitted the sample of water from the large lake, and that from the small lake, to settle for several minutes. Then I examined the water on the top, which still seemed somewhat clouded. I next examined the top mud at the waterline and the mud at the bottom. By this method I learned that most of the living things existed in the top mud, while the matter at the very bottom consisted chiefly of sand and heavy debris.

Every sample of top mud contained about 90 percent of uninteresting junk, which looked like rotted wood and seaweed. Lively protozoa pushed their way through—some lingered in the most densely packed areas. Many other creatures whirled and darted across the field, but the objects that interested me most were the tiny airship-like forms that floated past the remaining things. These, the free-floating diatoms, were long the enigma of biologists. They travel on their way with determination—going nowhere in particular, and this is one of the clews to their nature. They are not animals, as their gypsy habits would suggest, but plants that move about only to maintain a fresh supply of carbon dioxide and water flowing to their protoplasm. They consist only of protoplasm and an external skeleton. They are streamlined like a fish or airship for ease in slipping through the mud and water. Inside their siliceous skeleton is everything needed for the existence of a one-celled plant.

I SINGLED out this phase of the material for further study, neglecting all of the other jumping, whirling, darting, and creeping forms disclosed in the water from the two lakes. I found practically the same kind of objects in the large lake that I found in the small lake, but the water from the small lake contained more of them.

When looking for information on fresh-water diatoms my attention was attracted to the beautiful forms found in other parts of the world—in the ocean and in the rocks. I learned that these elementary living cells were found everywhere, even in the dirt in our fields; that 6,000 species were known—all beautiful, symmetrical in shape—circular, triangular, square, oval, or in combinations of geometrical forms.

The disk forms of diatoms are not free swimming but are anchored by gelatinous stalks excreted by the cells, the stalks often branching profusely. These diatoms have the form of the old-fashioned pill box and in reproducing, the smaller or inside section becomes a new diatom, which means that among the progeny there are a series of individuals of diminishing size. When this series has reached a minimum, what are called auxospores are formed—reproductive cells which start new diatoms of full size.

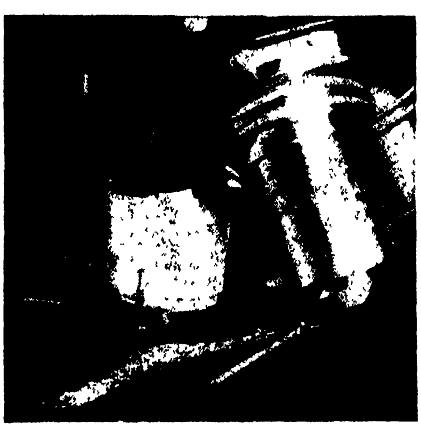
Diatom skeletons from accumulations are used commercially: in tooth paste and for polishing brass or varnished surfaces and the surfaces of optical equipment such as calcite prisms. They are also used as filters and as an absorbent in dynamite. Diatoms are sold on the market under a number of different names—diatomaceous or infusorial earth, rottenstone, kieselguhr.

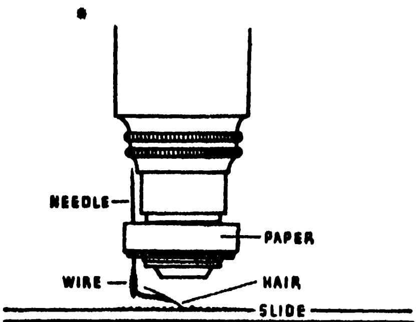
I have seen diatomaceous earth from the biological supply company, and diatomaceous material from several other sources. All this can be examined with a microscope giving about 100 magnifications, but to see the more intricate details, higher power is desirable. The *Amphipleura pellucida* has been used as a test for microscopic equipment for over 50 years. Although its general form can be seen with 100 or even less magnifications, the fine ribs that maintain its shape cannot be resolved except with the highest powered equipment. You can only hope to see the ribs or beads if you have a microscope with an oil immersion objective and a condenser that can be used in oil contact with the bottom of the slide. The condenser must have a numerical aperture equal to the objective, and the illumination must come in

Diatoms as they look when seen in their natural scummy surroundings

at an angle, perpendicular or obliquely to the lines in the diatom. Oblique light may be obtained very easily by cutting a disk of cardboard to fit the filter holder under your substage condenser. A quarter-inch hole through the periphery will give the oblique illumination necessary, and by rotating the disk, resolution of the lines may be accomplished—if you are a good enough microscopist.

In order to prepare photographs to illustrate this article I mounted a few diatoms in Canada balsam, in the following manner: For fresh water diatoms I took the fine top mud known to have diatoms in it and poured this into a test tube full of clean water. Diatom skeletons and some other debris remained on the top of the water in the form of a scum, and by touching my cover glass to this I was able to pick up the scum on the under side of the cover glass. Then, to continue outlining the procedure, by examining this under a low power (50x), a certain section containing many diatoms is selected, and while watching it through the microscope, other sections of the cover glass are cleaned free of all debris so that the material and diatoms in view under the microscope will be the only material on the slide. This material, still moist, is spread, by means of a fresh drop of water, to cover the entire center part of the cover glass. When this is thoroughly dry a drop of Canada balsam is placed on a clean slide and the cover glass inverted over this Canada balsam and pressed down. Now, by watching the section that it is desired to preserve under the microscope, the cover glass may be moved

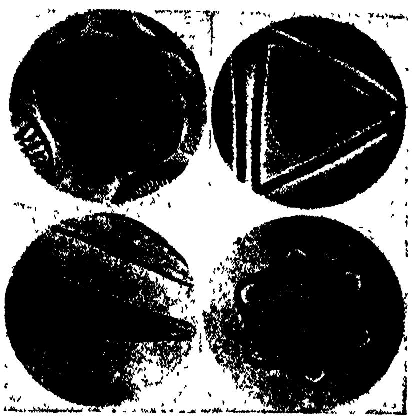




How the hair is connected directly to the objective and brought into focus under the lens, then used to pick up the diatoms, and clean and arrange them

around on the slide until the diatoms and remaining debris are so well separated that photographs or a permanent mount can be made.

If, on the other hand, you wish to follow the Old World custom of cleaning the diatoms and arranging them in a pattern on the slide, and think you have the patience required, the following procedure might be useful: Wrap the low power objective with gummed paper until you have built up a cushion through which you can pierce a needle. A bit of fine copper wire can be used through the eye of the needle, in order to hold a hair, and this hair, secured by wax or glue, is adjusted to focus. The gummed paper wrapped around the objective serves as a needle holder. A needle serves



Beautiful diatoms may be found in many alluring shapes and patterns

to hold a hair in position below the objective's focus. This gadget can be adjusted easily to the center of the microscope field. (See drawing below.)

WHEN the objective is focused on the hair, and also on a diatom, the hair can be used to lift the diatom from its position among broken pieces and place it in a clean spot on the same slide or on another slide. The hair can be moved up and down with the fine adjustment, and the slide moved in the horizontal plane by hand. If it is found difficult to lift the diatom with the hair, mix a solution of Canada balsam and xylol to make a paste thin enough to wet the hair, and sticky enough to pick up the diatom. A drop of xylol on the slide where you wish to deposit the diatom will help to free it from the hair, when you have it in position.

The procedure is very simple if you are of a patient nature. Draw a black mark around the section containing diatoms that you want to move, also a mark with a black grease pencil around the section in which you want to place the diatom. Focus your objective on the selected diatom, in order to find the di-

Cleaned, selected diatoms mounted on a slide make beautiful designs

atom on the hair. Then raise the objective by means of the coarse adjustment until you can see that the diatom is free from the slide, but that some objects on the slide are still visible. Move the slide by hand until the other area where you want to deposit the diatom comes to view. Then lower the objective and lay the diatom in position.

The diatoms should be covered as soon as possible, to prevent dust from getting on them. Canada balsam is the usual mounting medium, but mediums of higher refractive index are sometimes used, to give higher visibility. These can be obtained from a biological supply store. After mounting, your slide should be prepared in the usual way and sealed with shellac around the cover glass.

I discovered that these tiny skeletons would do ghostly things under high magnifications, and I was uncertain as to which of the many forms that I saw as I focused was the true form of the diatom. I read several books on the subject and learned that when no interference bands appeared I was looking at the true detail as it existed; and that when bands appeared around the object, I was probably looking at a light phenomenon caused by interference of wavelengths of light as they pass through the very fine structure of the skeletons.

IF one wishes to follow diatoms as a study, there is much to be learned. Books have been written on the subject, much time devoted to it. Photomicrographers pride themselves on their prints of diatom structures. Diatoms are full of mystery to the most profound student of biology and an intriguing subject to every owner of a microscope. You can buy slides of various grades, ranging from the simple Strewn slide at 50 cents, to the most beautiful pattern slide of test objects at five dollars. With these and slides which you can make, you can entertain yourself and your friends. The leisure hours will slip by unnoticed while watching this gala parade of micro plants.

From the Archeologist's Note Book

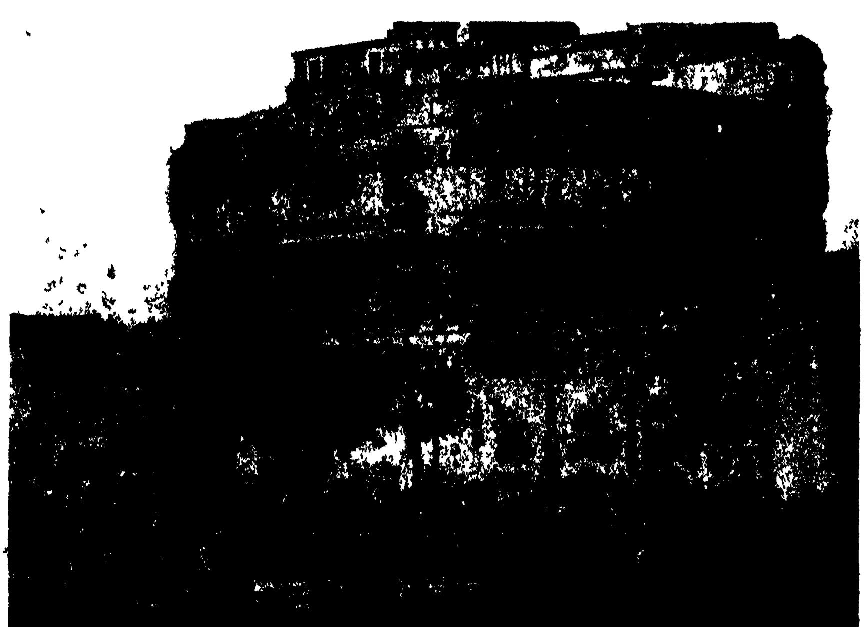
A Fortress Emerges

ONE of the old landmarks of Rome is the Castel Sant' Angelo, originally the tomb erected by the Emperor Hadrian for himself and his successors. It was completed in 139 A.D. by Antoninus Pius. On a substructure 275 feet square rises a cylinder 210 feet in diameter. The whole structure was once faced with marble. The great building was formerly surmounted by a smaller cylinder on which a colossal statue of Hadrian was placed. The total height was then about 165 feet. In 537 A.D. it was turned into a fortress and was many times besieged. Various additions were made and there were constant encroachments which destroyed the physical appearance of the structure. Now under the Fascist régime the ancient cylinder has emerged from the scrap heap and the whole area has been converted into a beautiful park which adds another beauty spot to Rome, one of the most attractive cities in Europe. A feature of the present work is the restoration of the overhead passageway, connecting the Castel Sant' Angelo and the Vatican, which was almost obliterated. The official name is now the Mole Adriano or the Tomb of Hadrian. We are indebted to the Italian Tourist Information Office for our photograph.

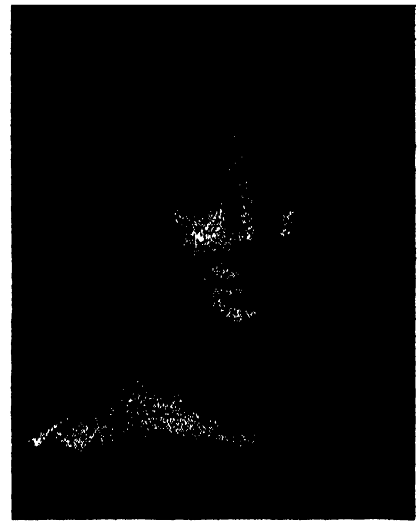
A bronze dish of Etrurian origin

An Etrurian Bronze

THE Metropolitan Museum of Art, New York, has acquired a bronze *Kyathos* (cup) emanating from southern Etruria, end of the 6th Century B.C. It is shallow with an offset, flaring lip, a foot with mouldings, and a high handle with lotus finial. The bronze has acquired a bluish patina, which is very attractive. The bowl was hammered, planished, and then spun to remove the marks of the planisher. The style is unmistakably Greek; this nation inspired much Etrurian metal work.



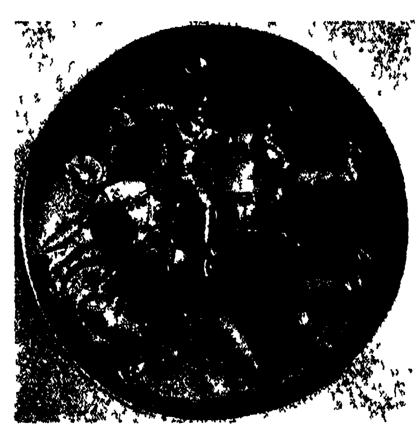
New Roman park converts the warlike Castel Sant' Angelo into peaceful channels



Chios Goddess, 4th Century B. C.

Greek Marble Head

THE Boston Museum of Fine Arts has a beautiful marble head which comes from the island of Chios, dating from the 4th Century, B.C. It was not unusual for the Greek sculptor to make the head of a figure separately and attach it to the torso. The present head apparently rested in a mortise in front of the torso; dowel holes are present. Persephone, Queen of Hades, best fits the character of the head, although Hera or some heroine or nymph may have been impersonated.



Sassanian silver dish

Sassanian Hunting Scene

AMONG the recent accessories of the collection of the Metropolitan Museum of Art is a Sassanian silver dish decorated with a hunting scene. Persian silver vessels of the Sassanian period (A.D. 226-637) represent the highest achievement of Oriental metal-work. The Sassanian artists excelled not only in stone sculpture but also in wall paintings and such minor arts as metal-work and textiles. Their metal-work, particularly on silver vessels, are extremely rare, only about 40 pieces being in existence. The royal hunt here represented was a favorite subject with these early silversmiths. The ibex is the animal being hunted.

Motordom's Ghosts Walk Again

By WILLIAM S. DUTTON

THAT most modern of institutions, the automobile industry, seems to have set out to demonstrate anew the truth of the adage that there is nothing new under the sun. Ghosts of the past are stalking in the laboratories of the industry's most ultra modern designers.

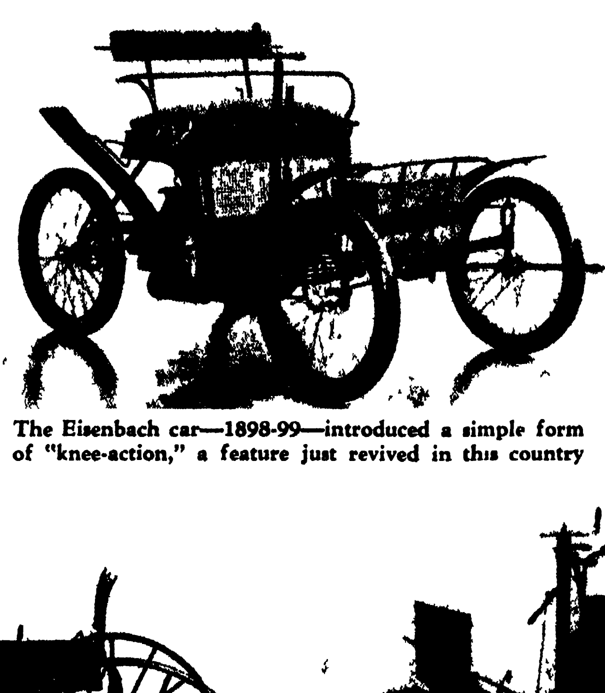
One feature of the big show presented by Henry Ford at the Chicago World's Fair, just closed, was a motor car body so radically different from the conventional that before it some millions of visitors stood in wonder of what a boldly progressive industry would dare next.

The shell was offered by a manufacturer of motor car bodies as its "suggestion for the motor car of the future." Daringly streamlined, the familiar hood in front merely furnished a compartment into which to stretch the legs and store baggage. Space for the engine was provided in the back of the unique body directly over the rear axle.

Rear-engine cars have been the dream of automotive engineers for the last several years, but to date no manufacturer has had the nerve to risk placing a model on the market. Such a wide departure from the established practice of putting the engine in front has been held to be too long a step forward for a habit-bound public to countenance, so that even now it is doubtful whether the "car of the future" will make its debut in dealers' sales rooms for two or three years more, if then. The public must be "educated up" to it, feel the automobile manufacturers.

"Educated back" to it would be a more accurate description. The facts are that in the proposed rear-engine car the engineers and designers are merely dreaming of the day when they can correct a 25-year-old blunder, which some day perhaps may be rated in transportation history as one of the automobile industry's most serious mistakes.

In another part of Mr. Ford's big white building at Chicago was presented a spectacular display of vehicular history from the chariot of ancient Egypt to the newest type motor car on our highways. Sixty-seven vehicles were in the display, the pick of a vast permanent collection of vehicles at Dearborn, Michigan, which numbers 220 automobiles of all types and makes and 560 horse-drawn carts, wagons, and carriages. Each vehicle presented at Chicago was significant of a step in transportation progress or change.



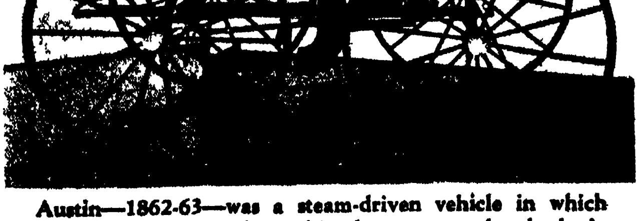
The Eisenbach car—1898-99—introduced a simple form of "knee-action," a feature just revived in this country

The earliest automobile in this most instructive "Drama of Transportation," since returned to Dearborn, is a steam-driven car built in 1862 or 1863 by one William Austin, of Lowell, Massachusetts. While resembling outwardly a horse-drawn carriage of its day, this 71-year-old equipage is, from the engineering standpoint, further removed from the influence of the horse than is the present-day motor car in all its glistening grace and pride and speed. Austin placed his engine, clumsy as it was, at the rear-center of his power-propelled buggy. The carriage had a wheelbase of 54½ inches and a tread of 55½ inches. The wheels were 45 and 46 inches in diameter, front and rear respectively. The fuel used was charcoal, chip-wood or scrap coal. The two-cylinder engine, held in place by a frame, had piston valves. The drive was direct to the rear axle, the latter acting as a crankshaft. The water tank was located at the rear end of the carriage.

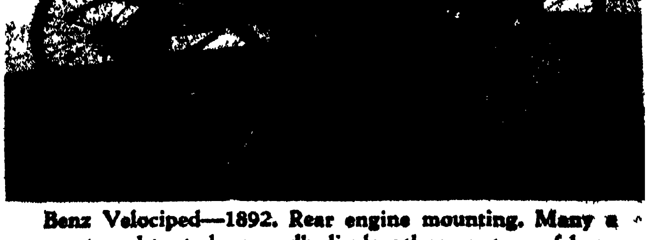
Later the Benz Company of Mannheim, Germany, founded by Carl Benz, famous in automobile annals, struck even further away from the influences of the horse and its traditional place in front of the cart. A Benz car built in 1891, and another of 1892, are in the collection and each has its engine located uncompromisingly in the rear.

Ford's own first successful car, built in 1893 and still in good running order, was a rear-engine type. Likewise was the Daimler of 1894.

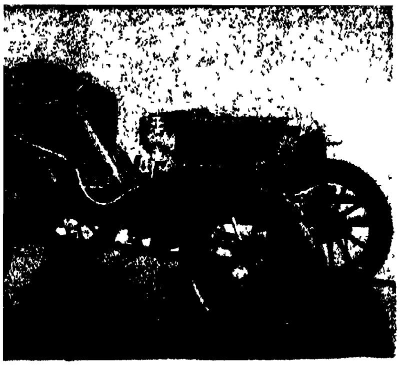
Looking back over these ghosts of progress as they have been arrayed side by side, even the lay visitor can-



Austin—1862-63—was a steam-driven vehicle in which the power plant was located in the center under the body

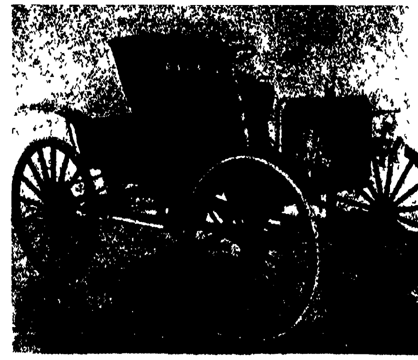


Benz Velociped—1892. Rear engine mounting. Many a sport roadster today proudly displays the same type of horn

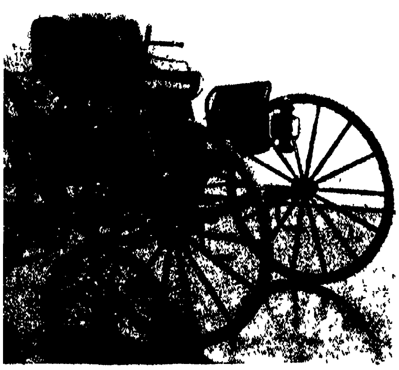


Pierce—1904

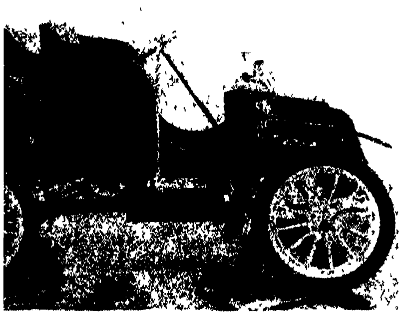
Riker Electric Tricycle—1896



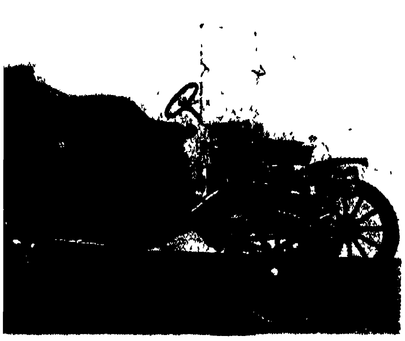
Schacht—1909



Holsman—1903



Pope-Hartford—1904



Ford T—1908

not help but be impressed by the unanimity of the pioneers' vision of what a motor car should be. Among a total of 37 significant automobile models introduced prior to 1910 and exhibited at Chicago, 14 were of the rear-engine type, six had their engines in the rear center, seven in the center, and only ten in front. That is to say, front-engine models were in the minority by the overwhelming odds of 27 to ten.

Of course it must be granted that the early builders were probably influenced more by expedience than vision. Power transmitted directly to the rear axle was the simplest and most economical form of construction. The fact remains, nevertheless, that it still is the simplest and most economical way to build a motor car, and the most sensible way. Engine heat, engine noise, and engine odors are removed to the place where least objectionable and noticeable when the power plant is in the rear of the car. There is more leg-room in front, and lack of leg-room was long an indictment against the earlier models with the power plant in front.

TRADITION and habit, the ever-present human reluctance to break loose from established forms, was the main reason for the front-engine automobile. The horse always pulled its load, and so the automobile makers finally contrived a way to get their power-plant where the horse would otherwise have been, though they continued to transmit the propelling force to the rear. And thus the new vehicle became a hybrid sort of thing, which presented the appearance of being pulled and yet actually was pushed from behind. It was neither fish nor fowl.

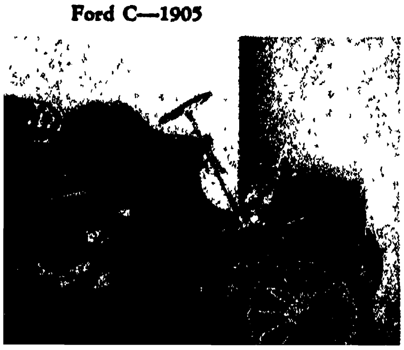
Just how many years of progress were sacrificed by the automobile industry to the tradition of the horse, or, to state it in another way, how much further advanced would be automotive design today if the pioneers had been guided solely by logic instead of by deference to age-old custom, is a nice question over which future historians may well speculate. It has taken us a quarter of a century to reach the point where a handful of advanced thinkers in automotive design are ready to admit cautiously that the car builders of the '90s were right when they placed their power plants behind.

INDEED, study of the motorized section of the Drama of Transportation is likely to lead one to wonder if there is anything fundamentally new or envisioned in the automotive industry of today of which the old-timers did not think. Lack of proper tools and materials, especially of metal alloys, made many of their ideas impractical at the time but none the less they had the ideas and in their experiments forecast the trend of future development with uncanny accuracy.

The self-starter is popularly supposed to be of fairly recent origin and one of the most important of later-day improvements to the motor car, yet it appeared on a Winton car in 1896. Standardization of parts, also thought of as a modern idea, was introduced by Ransom E. Olds, the designer and builder of the Oldsmobile, on an Olds car built in 1900. This car, known as a curved dash runabout, weighed only 800 pounds and was built in one style, with one paint finish, and each and every part was made to standard. The car averaged 25 miles to a gallon of gasoline and combined the principles both of air and water cooling.

Three-wheel cars have recently been the subject of experiment, though not by any of the larger manufacturers,

Ford C—1905



Oldsmobile—1900

Benz Phaeton—1892-96

Ford No. 3—1898

Crestmobile—1901

Michigan—1903

and the idea has been considered novel enough to interest motion picture audiences via the news reels. A car of the tricycle type, illustrated on the opposite page, was built by Anderson L. Riker in 1896.

AIR cooling and opposed cylinders are thought of today largely as innovations of the aviation industry, but about as many of the early engines were air cooled as water cooled. Such cars as the Holsman of 1904, the Stevens Duryea of 1904, and the Kilbinger of 1907 employed both air cooling and opposed cylinders in their motors. A Knoxmobile of 1902 introduced a most advanced principle of air cooling. Steel spines were inserted in the cylinder walls, screwed into place and grooved throughout their length. There were from 1500 to 2000 spines $^3/_{16}$ of an inch in diameter and two inches long.

Even independent wheel suspension, popularly known as "knee action" and widely exploited as a radical improvement of the past year or two, is really a ghost out of motordom's past. A car known as the Eisenach, built at Eisenach, Germany, in 1898 or 1899, incorporated a simple form of knee action in its front end suspension.

Progress of any kind is dependent on the past and its accomplishments, and Mr. Ford's huge collection of ancient and modern vehicles at Dearborn shows this unmistakably. Inventors do not draw new creations out of the air, like magicians, but working at the right time with the right tools they coordinate and assemble the findings of countless experimenters who have gone before and who, in their time, probably worked at the wrong time and with deficient tools and materials.

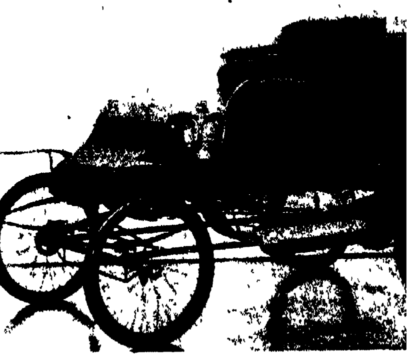
Even as late as 1893, the year Ford built his own first car, the mechanical facilities available were so meager that they would have been utterly inadequate to build a modern automobile. Prior to that date no sort of a successful car was possible, regardless of how complete and inspired the conception of the man who tried to build it. Too many needed things were then lacking.

In this connection it is interesting to note the roundabout course taken by automotive design in its present trend back toward the original rear-engine models.

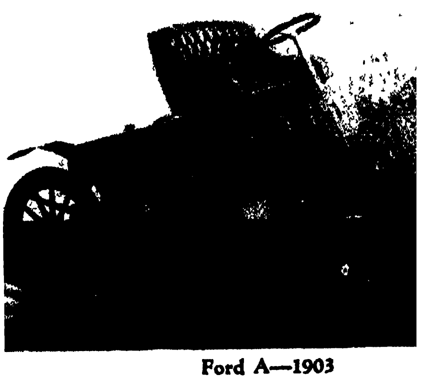
First, the horse led designers gradually to work their powerplants forward, though they had to overcome engineering difficulties in order to do so. Then along came aviation and we began to learn something of a new science, streamlining. Its discoveries quickly showed a glaring fault in the modern automobile: with its bulky engine and radiator in front it butted its way through the air instead of slipping easily through it. Streamlining suggested a rear-end power-plant, if a perfect job of streamlining was to be done.

SO our newest transportation industry, aviation, is exerting its influence upon motordom to free it from the last vestige of influence held over it by transportation's oldest industry. And the ghosts of the '90s walk again.

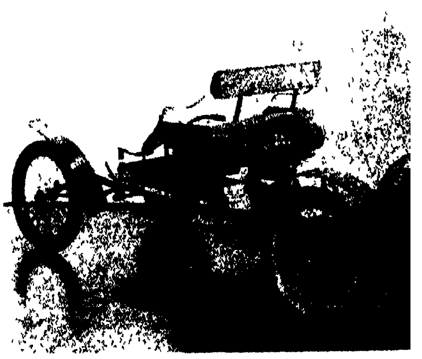
The photographs bordering these two pages admirably illustrate the points brought out in the accompanying article. Old as are the cars shown, they contain at least germs of ideas which are only now being developed. Old timers will recognize many familiar "gas buggies" of bygone days in this collection; the younger generation will smile at some of the seemingly grotesque designs, but can learn many lessons from a study of them.



Stanley Steamer—1902

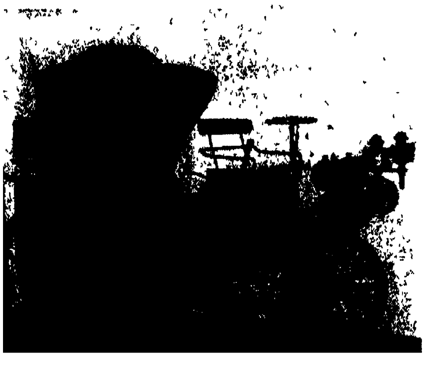


Ford A—1903



Orient Buckboard—1903

Daimler—1894



Winton—1900-01

Cadillac—1903

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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Movies Analyze Industrial Operations

A UNIQUE type of motion picture apparatus which visibly measures time in relation to human and mechanical energy was demonstrated recently to groups of industrialists in Rochester and New York City.

Chief features of the apparatus, which is sponsored by The Chas. E. Bedaux organization of industrial engineers, are a per-

Closed loop film set-up for analyzing movies of industrial operations

fectly synchronized camera and Kodascope projector using a super-sensitized 8-millimeter film. Powered by a constant-speed motor having an electric governor, the film travels through the camera at a rate of 1000 frames per minute in normal use and 4000 frames per minute for slow-motion pictures.

The camera, known as the Bedaux Measurement Cine-Kodak, weighs only six pounds with its built-in motor. It carries 100 feet of film which records 16 minutes of action, and is equipped with a lens held to a focal range of two to 20 feet.

Another feature of the apparatus is described as the "measurement loop system." This permits the recording of a large number of episodes, such as the multitude of operations in an industrial plant, and the cutting of the film into varying lengths corresponding to each episode, each length then being spliced into a loop capable of continuous projection at any desired rate ranging from one to 1400 frames per minute.

This apparatus was conceived to fulfill the need for a permanent record of every basic operation in a manufacturing plant, both as to the process and the exact time value of every motion involved. Through the use of these picture records it becomes possible to measure progress in processing, analyze motion for the elimination of faulty or unnecessary moves, permit management to see in terms of speed and fatigue their labor requirements and to demonstrate the fairness of these requirements, and give workers a constant and equitable gage of their performance uninfluenced by good times or bad.

With this system each complete scene is returned by the processing station to the

Motor-driven portable movie camera in use in an assembly plant

owner as a separate film formed into a closed loop and coiled in a specially designed file container card on which can be placed the data necessary to identify and classify the scene therein contained. Thus, as contrary to the procedure heretofore in vogue, when one desires to project the specific subject in interest he need not waste time viewing all the other activities photographed on the same roll of film.

The principle of a closed loop is of decided advantage during projection. The picture can be viewed as many times as desired without change of reels or rewinding. Therefore, the analyst, freed of the need of watching the mechanical operation of his projecting machine, can concentrate on the study of the picture itself for as long as he desires. When not in use, the loops are coiled in the loop record cards and filed in a loop record humidified cabinet for safe storage.

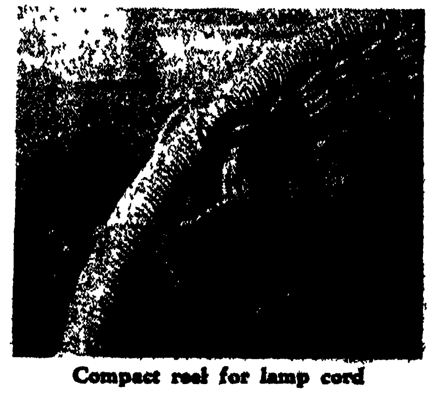
Water Purified by Iron and Carbon Dioxide

A NEW method for chemical purification of waste water, the iron-carbon-dioxide process, has been developed by German chemists, according to *Chemical and Metallurgical Engineering*. In this purifying process the waste water is treated with carbon dioxide in the presence of metallic iron, whereby iron is dissolved as iron bicarbonate. The dissolved carbon dioxide is then expelled from the water by strong aeration, the iron bicarbonate is oxidized and the hydroxide coagulated with the impurities in the water.

Waste flue gas with about 10 to 15 percent CO_2 may be used as a source of the carbon dioxide gas. Iron turnings from a machine shop are suitable for the other reagent. The total time required for treating the waste water is 30 to 45 minutes.—*A. E. B.*

Flexible Cord Reel

A CONVENIENT device for use in connection with reading lamps, electric irons, toasters, and other electrical appliances, takes the form of a compact reel in which 15 feet of flexible lamp cord can be



Compact reel for lamp cord

contained. One end of the cord is connected to a standard type of plug and the other to a receptacle in the center of the reel. Any length of wire needed to reach the nearest convenient outlet may be withdrawn from the reel or, when the device is not in use, the wire is easily rolled up.

A flexible wire arrangement makes it possible to clamp the reel to the back of a chair, a table, or any other desired point, or the reel may be merely placed upright on its flat base.

Texas "Oil Crop"

A SURVEY recently completed by the Texas Petroleum Council shows that oil has become the big "money crop" of Texas, far surpassing cotton. Returns from crude oil in 1933 totaled 237,872,000 dollars, compared with returns of 204,040,000 dollars from the cotton crop in the same year.

Stuttering Cured by Hypnotism

HYPNOTISM has been successfully used by United States Public Health Service doctors at the Marine Hospital in San Francisco in curing patients of stuttering, Dr. Victor H. Vogel, United States Public Health Service, reports.

The method includes revelation and aeration of the cause, and suggestion to the patient under induced hypnosis. It is especially applicable when the cause is psychic injury, such as severe abuse or fright occurring early in life, when the mind is most impressionable.

In some of the cases the causative incident remains only in the patient's subconscious mind and can not be recalled during the normal waking state; but when hypnotized, the patient readily relates all details. The suggestion is then given to the patient while in the state of hypnosis that, knowing the cause of his stuttering, he can overcome it. Success is not so marked when the cause is not revealed.

One patient, who could not recall the causative incident before being hypnotized, readily related it under hypnosis and recalled it to mind after being awakened. In this case the patient when about seven years of age had been severely whipped. While under hypnosis he spoke without stuttering. He was cured by three treatments. Two months later he wrote that "new worlds are open to me now." A year later he wrote that he was "selling insurance, which calls for enough talking." In normal conversations his speech was perfect, he said, while he slightly lost control and stammered "a bit" in times of excitement.—*Science Service.*

Science Service photograph

Florida's "Fountain of Youth" failed to bring eternal youthfulness to these Indians of Ponce de Leon's day. But archeologist J. R. Dickson reports that this old Indian graveyard, which he is unearthing, contains an array of strong-framed skeletons with remarkably fine teeth. The graveyard, recently unearthed, has revealed over 90 burials. Mr. Dickson calls them some of the earliest Christianized Indians in the United States, because many lie with arms crossed as in prayer, and because of the lack of offerings and equipment for the future world

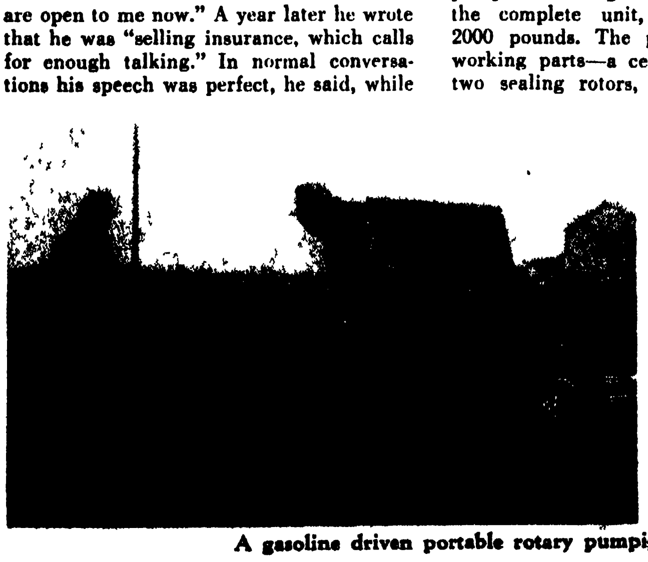
A Portable Rotary Pumping Unit

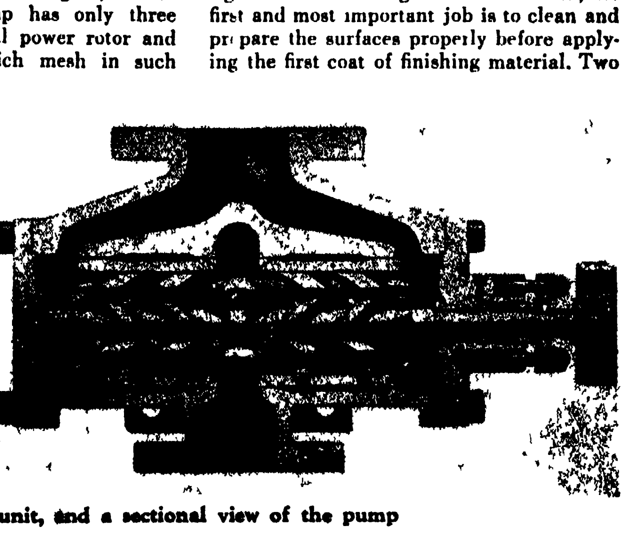
THE development of a high-speed rotary displacement pump has made possible the compact and comparatively light weight transportable gasoline engine driven unit mounted on a trailer, which is shown in an accompanying photograph. The pump is known as the De Laval-IMO. Driven at approximately 1675 revolutions per minute by a 60-horsepower gasoline engine, it delivers 90 gallons a minute against 495 pounds per square inch pressure with a suction lift equivalent to 14 inches of mercury. The pump itself weighs only 398 pounds, and the complete unit, with engine, about 2000 pounds. The pump has only three working parts—a central power rotor and two sealing rotors, which mesh in such manner that the liquid is carried through, as by a continuously acting piston, without shock or pulsation. There are no timing gears or separate bearings, and but one stuffing box, which is subjected to suction pressure only.

The rotating parts are in complete rotational balance and, except for suction pressure against the area of the driving spindle at the stuffing box, are also in hydraulic balance axially.

How to Paint Cast Aluminum

AN improved technique for painting cast-aluminum surfaces is reported by J. E. Greene in a recent issue of *Industrial Finishing*, as a result of work done to improve the finish and durability of street and road signs. In the finishing of cast aluminum, the first and most important job is to clean and prepare the surfaces properly before applying the first coat of finishing material. Two





A gasoline driven portable rotary pumping unit, and a sectional view of the pump

solutions for this purpose are recommended: One is a caustic potash or concentrated lye mixed on the basis of two pounds to the gallon of water; the other is a 25 percent solution of acetic acid.

Aluminum castings are dipped in a tank of one of these conditioning solutions and allowed to hang submerged for 20 to 30 minutes, or until the surfaces turn to a grayish black. Next they are dipped into a tank of cold water to rinse and neutralize the first treatment, and then into a tank of hot water. Following this, the castings are allowed to dry naturally, after which they are ready for the priming coat.

In one modern plant, exterior lacquer enamels are used; another uses air-dry and bake-type synthetic enamels. For the lacquer finish a red oxide lacquer primer is first applied. The work is then painted in various combinations of color and finished with a final protective coating consisting of one or more coats of exterior, tarnish-proof, clear lacquer.—*A. E. B.*

The *Brazilian Clipper* alighting with flaps depressed

Brazilian Clipper Triumphs

THE *Brazilian Clipper*, the Sikorsky S-42, which we have already briefly described in these columns, has gone from triumph to triumph, exceeding the specification performances, breaking many records, and cutting time in its regular South American service. The S-42 has aroused world-wide interest and we feel fully justified devoting space to the latest information regarding this splendid ship.

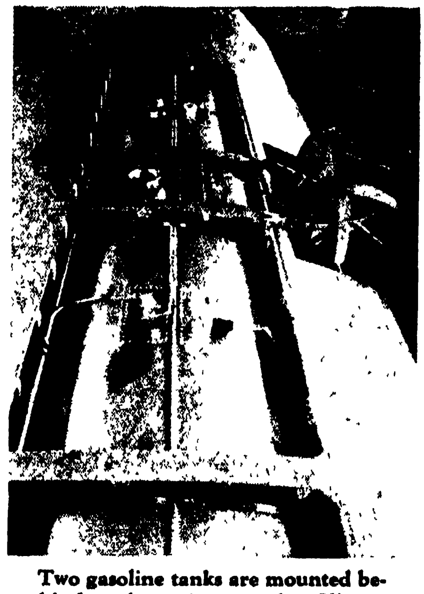
The performance with various engine combinations is of particular interest. With full load—36,000 pounds total—and all the four Pratt & Whitney Hornets, rated at 700 horsepower each, in commission, the top speed is 190 miles per hour at 6000 feet altitude. With any of the three engines, the top speed at sea level is 153 miles per hour. With four engines, climb is 1000 feet per minute from 3500 feet; with any three engines, the climb there is still at the comfortable figure of 400 feet per minute. In this flying boat the question of enhanced safety by use of a multi-engined power plant is fully answered, with no further argument possible.

The weight empty (that is, fully equipped but without fuel, oil, crew, or pay load) is 21,945 pounds, so that the useful load is at least 14,055 pounds. Since the S-42 only loses a couple of miles per hour in speed when overloaded up to 41,000 pounds and is then perfectly easy to handle, its maximum useful load is 19,055 pounds or nearly 50 percent of the gross load.

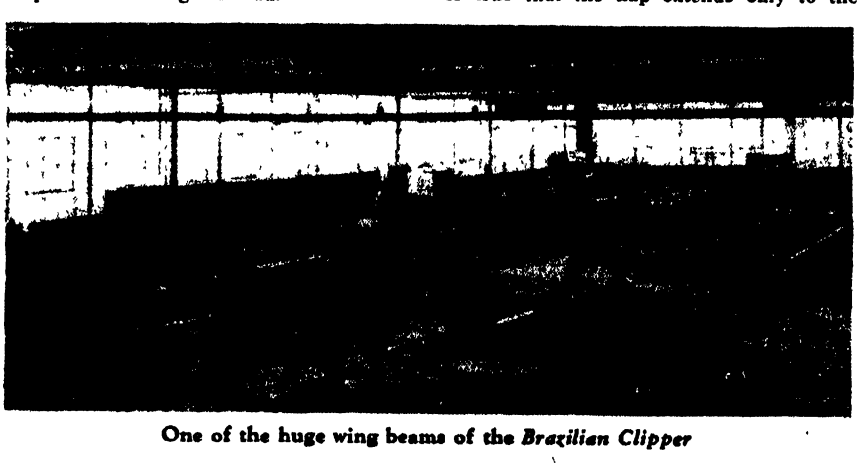
We have always claimed that large flying boats suitable for oceanic service should be equipped with the same care and completeness as an ocean liner. In the *Brazilian Clipper* the total weight of equipment is 2181 pounds, and comprises the following list of items, not one of which is superfluous and all of which are desirable:

Hat Holders	Tool Kit
Fish Oil	Water Containers
Flash Light	Tables
Hand Axes	Coat Rails
Utility Rope	Smoking Stand
10 Quart Pail	Table Racks
Air Rafts (3)	Life Buoys
Spare Parts Kit	Fire Extinguishers
Automatic Pilot	Drinking Fountains
Flit and Spray Gun	Towel Holders
Machete	Toilet Paper Holders
Paper Cup Holder	Sanitary Pad Holders
Radio Wiring	Signs and Frames
Food	Magazine Holders
Life Jackets	Batteries
Anchor	Landing Lights
Anchor Cable	Generators
Fog Horn	Towing Pendant
Ship Bell	Pilot Seat Cushions
Very Pistol	Safety Belts
Boat Hook	Anchor Winch
Heaving Line	Radio Table
Water Canteens (3)	Radio and Mech. Seats
Food Box	Carpets
Bilge Pump	Curtains
Sea Anchor and Line	Steward's Seat
First Aid Kit	Radio, Complete
Parachute Flares	Radio Antenna
Misc	Starter Handle
(Books, et cetera)	Starters
Entrance Railing	Ring Cowling
Strong Box	EngineFireExtinguishers
Cupboards	Oil Regulators

Colonel Charles A. Lindbergh is the Technical Consultant for Pan-American Airways who purchased the ship, and himself carried out a number of the acceptance tests. One of our photographs shows the *Clipper* just about to land with Lindbergh at the wheel. Our readers will notice that the landing is made with flap depressed. It is true that the flap extends only to the ailerons, but it is huge nevertheless and no pilot can quickly operate it by manual strength. Hence an ingenious flap control mechanism has been worked out. This mechanism is shown schematically. The mechanism is hydraulic, with control handles suspended from the cockpit roof near the throttles. A master actuating cylinder, supplied with oil under pressure from an electric power-supply unit, pulls the flap down through direct cable and pulley connections to the control horns. The flap is raised by the action of six small cylin-



Two gasoline tanks are mounted behind each engine on the *Clipper*



One of the huge wing beams of the *Brazilian Clipper*

ders (three to each flap section) mounted in the trailing edge of the wing, with plungers directly connected to the flap horns. An important safety feature is embodied which prevents the use of the flap when the flying speed is too high for it to be safely employed. In such a case the air loading on the flap becomes too high and by an ingenious arrangement of pressure relief valves and by-pass connections the flap is allowed to rise till its loading is again normal. As air loads ease off, the flap automatically returns to its original position.

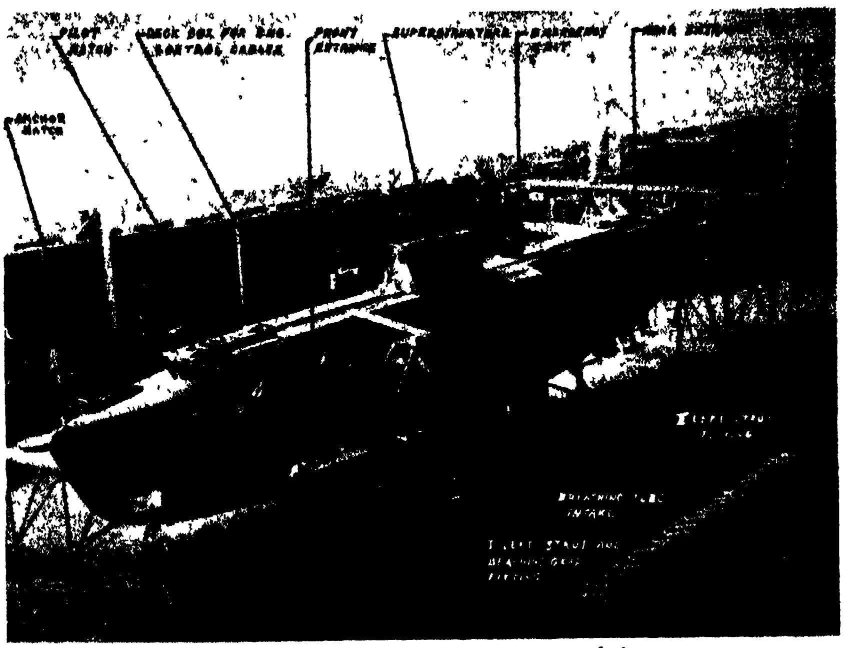
In the photograph of the hull nearing completion may be seen many important points. At the very front end is the anchor hatch, with the anchor hawse pipe at the bottom. Then there is the pilot hatch. On

the top of the hull is the deck box for the complicated engine controls and cables. The front entrance is on the left or port side. Immediately in back of the superstructure on which the wing is mounted, there is a rear emergency exit. The rear entrance is on top of the hull. Strut fittings are also indicated in this photograph.

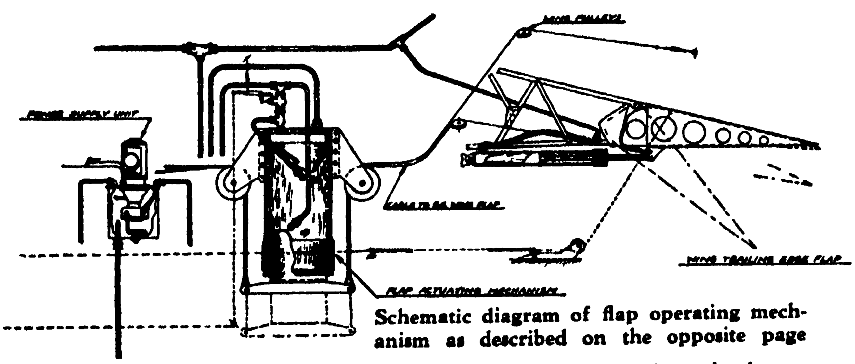
There is not space in these columns to illustrate all the complex devices and structural elements required. We can only select vital elements.

The tremendous wing spar is continuous from tip to tip, of a modified Warren truss type, and is composed of extruded and built-up dural sections, assembled by riveted and bolted-on gusset plates. For the flange members (that is, the long members top and bottom) a very ingenious extruded C section with a uniform thickness of 3/16 of an inch is employed. In highly stressed locations the C section is reinforced by the insertion of telescoping half-round tubular liners of dural. Where extra strength is required steel bolts are also substituted for rivets.

In the interior of the hull, accessibility for maintenance is excellent. The main hull framing consists of a deep girder keel of which the stem and stern posts are integral parts. There are eight built-up bulk heads all equipped with leak-proof doors to divide the hull into nine water-tight compartments. The many stringers, longitudinals, and outside plating are riveted together to form a structure almost as solid and permanent as the hull of an ocean liner! All seams are sealed with impregnated cloth during fabrication. To guard against corrosion, anodic treated dural is used throughout. Flush riveting is used so that the outside surface is perfectly smooth. The main bulk head extends downward to form the front step and upward to provide the rear superstructure bulk head to which the rear wing spar is attached.



The *Brazilian Clipper* hull nearing completion



Schematic diagram of flap operating mechanism as described on the opposite page

Mounting of an outboard engine; wing-tip pontoon in background

Another photograph shows the mounting of the outboard engine on the wing, with its Venturi cowling, and three-bladed adjustable pitch propeller. The engine is carried by welded steel tubing attached directly to the spars and no attempt has been made to insulate engine mounts with rubber. Nevertheless, no vibration from the engines is noticeable in the cabins. The mass of the wing is evidently large enough to dampen out engine vibration before this reaches the cabin. The fuel is carried in eight elliptical riveted dural tanks of 150 gallons each, supported by the drag trusses between the main wing spars. The tanks are arranged in pairs behind each engine.

The boat represents the results of a lifetime of experience for Igor Sikorsky, and his able Chief of Design M. Gluhareff. —*A. K.*

Air Capers

It is sometimes refreshing, after reading the learned but endless reports of the aerodynamic laboratories of Europe and North America, to have a heart-to-heart chat with a practical and finished flyer. We are referring to Gevhard Achgelis, a German pilot, pupil of the famous Udet, who thrilled thousands of spectators at the Cleveland Air Races with his wonderful stunts. Strange to say, Mr. Achgelis understood the writer's German, spoke no English, and was glad to converse freely in his native tongue.

We have in this country the most finished naval and military aviators. At Cleveland the "Flying Trapeze," composed of three planes flown by service pilots, flew but a few feet apart and simultaneously performed loops and wingovers with delightful ease. The "Lufberry Circus" was also amazing to watch. Planes flew in single file, each imitating the one ahead, and playing a gigantic game of "follow the leader" in the air.

Al Williams made power dives, zooms, and wingovers with his usual precision. But there is one art in which our pilots perhaps lag, and that is the art of fantastic capers near the ground, and this art Achgelis demonstrated to our heart's content. It is true that he had a very lightly loaded ship with oversize controls, but to watch him side-slip within a few feet of the ground, cut the grass with one wing tip, and make his plane stagger in drunken fashion, all quite evidently with perfect control of his craft, was awe-inspiring. We criticize him only for making an inverted loop over the grandstand—a perfect feat, but one which meant danger to dozens of spectators. —*A. K.*

The Cleveland Air Races

THE Air Races of 1934 were a remarkable success. Every event passed off with perfect smoothness and without the slightest confusion, in brilliant sunshine and cool weather. On Labor Day some 90,000 people witnessed the most interesting events of the series. Instead of Air Race Week dragging along over a period of ten days it had been compressed into four days with great benefit to all concerned, spectators and contestants alike.

Air Race Week was marked by one disastrous event—the death of Doug Davis—who had already won three prizes and was leading in the Thompson Trophy Race for machines with unlimited power—the air speed classic of the United States.

The cause of this accident is readily ex-

plained. Times are hard nowadays and backers for entirely new ships are difficult to find. Hence, instead of exhibiting novel planes of more refined design, the racing aircraft constructors contented themselves with merely installing more powerful engines and relying on brute force to give greater speed.

Now, the installation of a more powerful engine in a good plane is not so very dangerous in straight, cross-country flying in moderately bumpy weather, but in the Thompson Trophy Race, with its short laps of 8⅓ miles around four pylons (the short laps were arranged, naturally, to give the crowd a greater thrill) the pilot is almost never flying on a straightaway. With his high burst of speed, something over 300 miles an hour at times, he flashes over the course and attempts to negotiate the 90-degree turn at the pylon with a minimum loss of speed. To lose little time at the pylon the proper procedure is neither to zoom up nor to dive down, but simply to make a rapid, tight turn. The more powerful the engine the greater the speed, and the greater the centrifugal loads which may be imposed on the ship in such a turn. At the same time, the more powerful the engine, the more violent the slipstream of the propeller, the greater the control available to the pilot for tightening the turn.

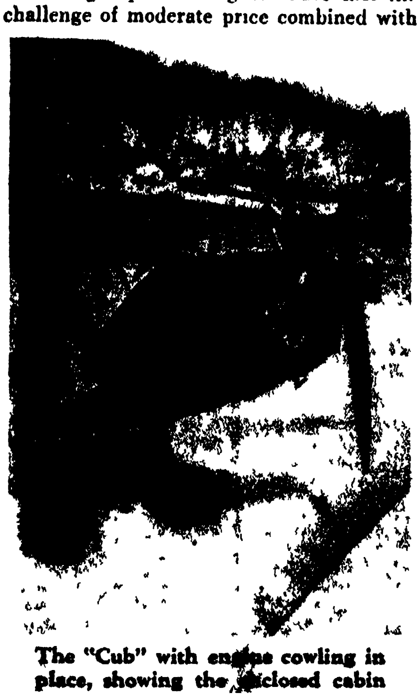
In Doug Davis' ship the power had mounted from something like 430 horsepower in the Junior Wasp to perhaps 730 horsepower in the Senior Wasp. With the fever of the race in his blood, leading the field by half a lap, Davis perished through failure of a wing, brought on undoubtedly by the tremendous centrifugal forces experienced.

Next year a Racing Pilots' Association is to be formed to inspect the planes before each race.

Light Planes and Moderate Power Engines

THERE is at the present time quite a revival of interest in low-powered planes; that is, planes with engines of something under 60 horsepower.

Our light plane designers have met the challenge of moderate price combined with good efficiency, and for less than 1500 dollars it is now possible to buy an efficient, thoroughly good flying machine of easy maintenance suitable for the private owner flier of moderate means.



The "Cub" with engine cowling in place, showing the enclosed cabin

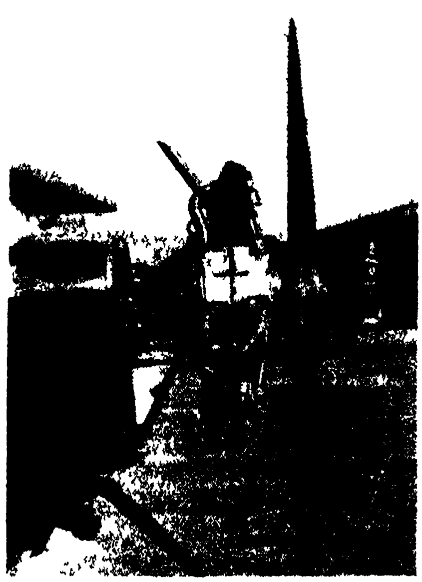
The new Luscombe "Phantom" for private flying

An excellent example of the low-powered plane lies in the Taylor "Cub" which is powered with the Aeromarine AR3-40 engine and illustrated in the two photographs. The occupant of this small ship is given enclosed cabin protection by a very complete wind shield in front with openings at the side of the fuselage.

The Taylor "Cub" has, according to the manufacturer, the following specification:

Weight Empty	528 lbs
Useful Load	412 lbs
Gross Weight	940 lbs
Take Off Run	120 ft
Climb (first minute)	600 ft
High Speed	94 m p h
Cruising Speed	85 m p h
Cruising Range	175 miles
Gas Consumption	3½ gals per hour
Gliding Ratio	10 to 1
Landing Speed	30 m p h
Landing Run	100 ft

A great deal of the increase in interest in the low-powered plane lies in the fact that satisfactory engines are now available. Thus in the Taylor "Cub" the engine employed develops 40 horsepower at 2050 revolutions per minute. The AR-3, which is very similar, develops 50 horsepower at 2100 revolutions per minute.



Simple yet strong engine mounting used on the Taylor "Cub" described

The Aeromarine light engines have been approved by the Department of Commerce, are in use in many light planes in this country, and have also been shipped to Brazil and Czechoslovakia. While only three cylinders are employed, the balance and smoothness are all that can be desired. The weight without hub and with two magnetos is 150 pounds. The bore is 4⅛ inches and the stroke is 4 inches.

Some elements in construction are as follows: The cylinders are of forged steel with heat-treated aluminum-alloy heads. The valves, push rods, rocker arms, and tappets are entirely enclosed in oil tight castings. The magnesium crank case is divided into two parts which are very easy to assemble and maintain. The entire assembly of the crankshaft and its adjacent parts is made independent of the rest of the engine. The regular standardized mount is provided for starter and generator.

A light engine of this type is bound to help private flying considerably.—*A. K.*

Private Flying Goes Ahead

WE were recently invited by a prominent private flyer to take a hop in his new "Phantom" put on the market by Don Luscombe a short time ago. Just a short flight over North Beach Airport brought home to us very forcibly what remarkable progress planes built for private owners have made in recent years.

First of all there was perfect vision. The Pyralin windows, front, side, toward the rear, and up above, gave us as complete a view of the landscape as in the most unprotected open cockpit. A scoop at the front and a ventilation opening at the rear of the cabin gave fresh air, without drafts, with all windows closed. A comfortably padded seat with a safety belt that snapped shut in an instant made an excellent impression. With the monocoque dural fuselage to replace the old fabric covered fuselage, there was not the slightest rattle or vibration anywhere. This freedom from vibration is due also to the perfectly running and well balanced engine, rubber mounted.

Of course, our host and pilot was a master of the art. Nevertheless, it is remarkable how such a modern cabin plane as the "Phantom" responds immediately, neatly, "tidily," to its controls. The writer of this note, a most indifferent pilot, was strongly tempted to take a hand. The rapid take-off was matched by the easiest of landings, using the flaps.

The flaps nowadays are no longer manually controlled, which is fortunate, since control stick and throttle usually engage the pilot's attention in landing. The flap on the rear of the wing is actuated by a small electric motor which turns the shaft about

which the surfaces hinge. The motor stops automatically at the proper full position without any attention. The only adjustment required is a slight lowering of the horizontal stabilizer to prevent any possible nose heaviness.

These new private planes are equipped with everything the heart of a man can desire—luggage space, instruments of every kind, landing lights, starting motor, and so on. They are fully as well equipped in their way as the large transports.

With a 145 horsepower Warner engine and a gross weight of 1950 pounds, a cruising range of 560 miles and a top speed of 168 miles an hour are realized. The landing speed with flaps down is 45 miles an hour.

Our photograph shows a front view of the machine with its trim lines. The reader will note that the landing gear is entirely cantilever with all bracing hidden.

With planes such as the Luscombe "Phantom," and with more and more airports and landing fields, it is not surprising to hear that at the Cleveland Air Races some 45 Monocoupes and as many Fairchilds and Wacos were flown in to see the races by private flyer-owners.—*A. K.*

Indoor Bombing

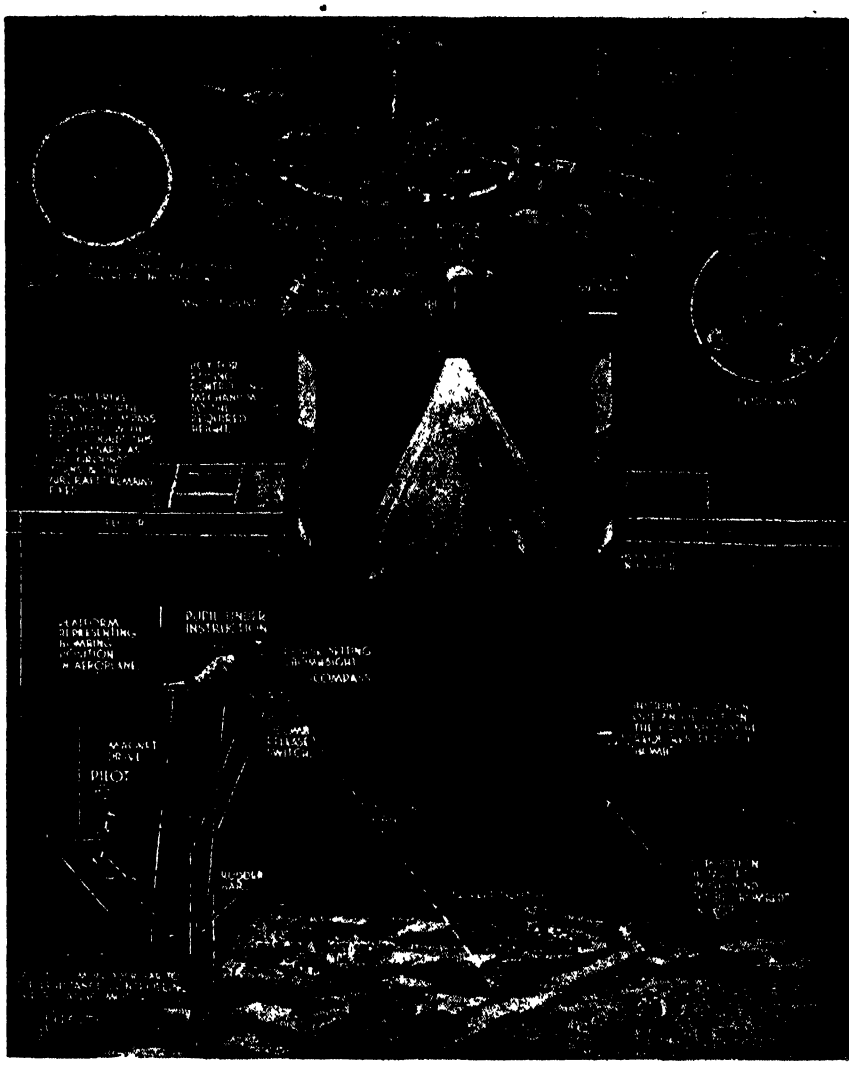
BOMBING from the air is now a very complicated art and is no longer simply a matter of flying an airplane over a target. A great many factors have to be taken into consideration, such as the altitude and speed of the plane, the direction and speed of the wind, the aerodynamic properties of the bomb, and so on.

The most sensitive instruments, involved calculations, and close co-operation between the bomber and the pilot are required. To train a bomber is a long and delicate business. It requires much work with practice bombs dropped from an airplane, as well as a lengthy course of instruction on the ground.

British aircraft squadrons are now adopting the Vickers-Bygrave Bombing Teacher with excellent results. An artist of *The Illustrated London News* has prepared a diagram of the new bombing trainer which is almost self-explanatory, with perhaps the following additions:

Instruction takes place in a darkened room, the floor of which is whitened. On this floor is projected, by means of a lantern slide, an aerial photographic mosaic printed on a transparency 10 inches square. This represents some 1600 square miles of country. The scale of the transparency is about 1 to 200,000 so that it is impossible to show very fine details. There is, however, sufficient detail for the recognition of ground marks and for production of a realistic representation of the ground as seen from a height of 8000 or 9000 feet. The pupil under instruction is lying prone on a platform which represents the airplane. By means of the mechanism shown, the image of the ground is moved towards the platform from various directions, thus simulating the effects of wind on the course of the aircraft. Thus it is possible, by means of this apparatus and various timing devices, to imagine the airplane as approaching the target from any direction at a variety of speeds, with flat, slow turns, and so on.

The platform itself is fitted with navigation and bombing sighting equipment for the use of the student under instruction, and a seat and rudder bar for the pilot. Pupil and pilot are in communication by means such as are normally used in bombing airplanes.



The equipment used for indoor bombing practice

When the pupil has calculated the direction and force of the wind and has sighted on the target, he throws a switch which represents the bomb release. A device defines an interval equal to the time taken by the bomb to reach the ground. At the end of this period the movement of the projected slide is stopped. Painted on the floor of the room is a fixed trail point which marks the point on which a correctly aimed bomb should drop. Any error may be seen by the difference in the positions of the target and the fixed trail point. Exercise with this device is said to save a great deal of time and expense in the air.—*A. K.*

Glass Wool Made by Centrifugal Force

SHREDDING glass into wooly fibers by centrifugal force is the unique process developed by a Swedish manufacturer of glass wool. Melted glass runs down upon a disk which rotates with great velocity. By action of the centrifugal force, the glass is disintegrated into a mass of extremely fine threads. A current of air is blown downward around the edge of the rotating disk, carrying the formed glass wool down upon a cutting and transporting apparatus, by means of which the product is continuously carried away for further working. The fineness of the glass threads can be controlled within certain limits by regulating the temperature of the melted glass and the amount of glass fed upon the rotating disk per unit of time. By the method described, much finer threads can be produced than by other methods. Insulating mats manufactured from the glass wool by pressing and sewing contain only approximately 4 percent of glass by volume.—*A. E. B.*

Milk In Tuberculosis

SINCE ancient times milk has been recognized as a valuable adjunct in the feeding of the tuberculous sick. With all the advances in the treatment of tuberculosis this perfect food has not lost its prestige but still remains the one most important article of diet for these patients.

At one time before the modern era of clean, pasteurized milk, and the eradication of tuberculous cattle, other forms of tuberculosis, not of the lungs, were not infrequently encountered. Whether because of, or coincidental with these procedures, true it is that analysis of all types of cases of tuberculosis reported shows a steady decline in the actual and relative numbers of extra-pulmonary types of tuberculosis. Certain it is we now no longer seem to see as

many people with spinal, hip or glandular disease walking the streets as in former years. In other words, milk in general, always the best of all foods, is now also safe for human consumption.—*Health News* of the New York State Department of Health.

Mustn't Cuss on Short Waves

BECAUSE of the large numbers of possible listeners-in on short wave radio sets, Forest officers are finding it necessary sometimes to tone down their working vocabularies, even under the stress of battle with the flames. Strict orders against "cuss-words" in radio messages have been issued, the Forest Service revealed recently, in reporting that more than 600 radio stations have been installed for emergency communication in the national forests.

Now that short wave receivers have become so popular, radio gives far less privacy than even the old-fashioned party telephone line, according to the Forest Service. Thousands of listeners are picking up the Forest Service messages, and occasionally getting a real insight into the many difficulties and problems foresters have to meet in quelling fires in the woods.

Movie Camera and Projector Combined

A COMBINATION camera and projector for taking and showing amateur motion pictures has recently appeared on the American market under the name of Midas. This instrument not only has the feature of

combining two functions, but the actual taking of the pictures is achieved without the use of either a hand crank or a spring operated motor.

The camera is composed of two separate housings, one of which contains four standard sized flashlight cells. These operate a tiny but powerful electric motor which drives the film during exposure. It is claimed that the four small cells will operate the motor long enough to take 50 reels of film, each 30 feet in length. When the instrument is used as a projector, the cells furnish current for lighting a small incandescent bulb. While it is also possible to operate the film during projection by means of the contained electric motor, better lighting of the screen is obtained if the hand crank is used for running the film.

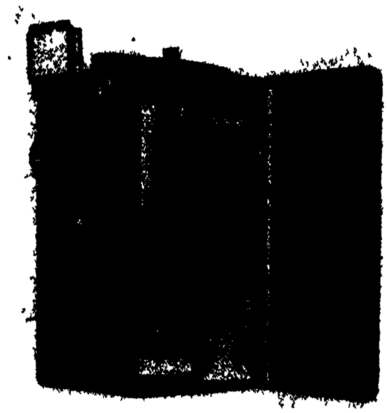
The lamp usually used is a 4.8 volt light operated on an over-load and consuming approximately 2.5 watts. The illumination is sufficient to throw a picture about three feet to a screen approximately 16 inches wide. The motor which drives the film consumes from .5 to .8 of an ampere under load.

The film used is 9½ millimeters wide with center perforations between the frames. Thus a picture on the film is obtained which is almost as large in area as on a 16 millimeter film, since the 9½ millimeter frame extends to the very edge of the film. The 30-foot reel of film will give approximately 2½ minutes of continuous action.

The camera is equipped with a *f*2.5 fixed focus lens which is provided with a diaphragm for controlling the amount of light. The same lens is used for both taking and projecting pictures.

Cellulose Acetate Business "Booms"

ONE of the industries that have been "booming" in spite of the depression is cellulose acetate. Indeed, cellulose acetate sales during the worst year of the depression were over twice as high as in the top year of the preceding boom. Of



Left: **Amateur movie camera-projector that uses dry cells.** *Above:* **Battery box open, showing cells.** *Right:* **Inserting the center-perforation film in the simple gate provided**

course, this was due to the fact that many new and important outlets for this chemical product have been developed since the depression began—"Celanese" rayon, safety glass, non-flammable film, transparent wrapping material, and plastics. Arthur D. Little's *Industrial Bulletin* explains some of the reasons for the growing use of cellulose acetate as follows:

"Acetate rayon, such as 'Celanese,' consists of fibers of cellulose acetate instead of the simpler regenerated cellulose of viscose rayon. As dyes used for other fibers have in general no effect on acetate, and since many of the new dyes developed for acetate affect no other commercial fibers, acetate is widely used for cross-dyeing. The low moisture absorption of acetate tends to prevent its shrinking and swelling. Its extensibility reduces bagging and wrinkling. Early difficulties in weaving acetate yarns have largely been overcome, and distinctive new fabrics developed. The popular dull finish is excellently produced upon acetate without loss of the fiber's soft 'feel.'

"The trend of demand for rayon is strongly toward finer filaments, as these may be woven into softer fabrics, with better appearance, feel, and covering-power. Acetate lends itself particularly well to the spinning of these fine filaments, for, whereas the spinning speed for viscose rayon must be decreased with decrease in filament size, acetate filaments of even the finest commercial deniers may be spun quite rapidly.

"Increase in the use of cellulose acetate sheeting, as the plastic filler sandwiched between two glass plates to form safety glass has been spectacular. Since 1932, before which its use for this purpose was negligible, acetate has all but entirely displaced Pyroxylin.

"Cellulose acetate films include not only the slow-burning safety-film used for home movies, X-rays, and so on, but also a transparent wrapping material which is claimed to provide a closer, more even, and more uniform fit in packaging. Cellulose acetate plastics, though as yet relatively unimportant, continue to find favor for certain applications, chiefly because of their slow-burning qualities and their stability to light and heat, without discoloration or loss of transparency or translucency."—*A. E. B.*

When to See a Doctor

OUR present system of consulting a physician only when pain or distress drives us to it is old-fashioned. As a result we are not benefiting as fully as we might by the modern discoveries of medical scientists.

This, in effect, is the contention of Dr. Stanley H. Badock, Pro-Chancellor of the University of Bristol, England.

The physician could do much more to keep us healthy if we laymen were not "still

thinking of recipes for keeping the doctor away," Dr. Badock pointed out in his presidential address before the Congress of the Royal Sanitary Institute.

We are still thinking of the doctor "exclusively as the curer of our diseases instead of as the guardian of our health," he charged. This is not in keeping with the new viewpoint of physicians with its emphasis on the preventive aspects of medicine.

The physician is now equipped with an armory of weapons to confer immunity against many diseases and he is increasingly conquering disease by working with nature to stimulate the natural defenses of the body. Physicians generally are agreed that their services are often sought insufficiently early, when the disease has already made itself felt and is perhaps somewhat advanced, and when a much earlier consultation would have made a complete cure more possible.

"It is obviously undesirable that we should be watching for early symptoms in

our own bodies, even if we were qualified to observe them," Dr. Badock stated. "But it is equally clear that the present system does not give the general practitioner the preventive scope which he desires."

One solution of the problem which is favored by physicians and health authorities both in England and America, although Dr. Badock did not specifically mention it, is the system of yearly examinations or birthday health examinations, as they are sometimes called.—*Science Service.*

The Plumber Had a Silver Mine . . .

HOW a smart plumber in Hollywood called attention to the need for some chemical engineering in the studio is related by A. B. Laing in *Chemical and Metallurgical Engineering.* In the laboratories of the movie producers, where vast quantities of film are developed and printed every day, the solutions used in the processing were known to contain considerable quantities of silver dissolved from the film during "fixing." One particular studio had constant trouble with clogging of the pipe line leading from the tank in which used "hypo" was stored. Each time the same plumber was called in to make the necessary repairs. To every call he responded with remarkable promptness, digging up the pipe, removing the old lengths, and replacing them with new pipe.

Suspicion was finally aroused, particularly because the bills presented for this service seemed too low in view of the work involved. Upon investigation it was found that by laying some lengths of pipe out of level, at the end of the line, which would always be filled with old hypo solution, the plumber had deliberately constructed a hypo-trap of about 100 feet length, in which silver dissolved from the films during the process of developing was precipitated on the metallic iron.

It was therefore a veritable silver mine which the ingenious plumber had been diligently working up to the time when the owner of the studio, exercising his priority rights, jumped his claim and terminated his highly profitable "contract."

Since that time several methods of processing high-silver hypo solution have been worked out with the result that much silver is recovered from the spent "hypo," and, in addition, the new methods keep the hypo fresh and simplify film development. —*A. E. B.*

Where Old Oil Tankers Go

UNSEAWORTHY oil tankers are being used as storage tanks in the lake and bayou regions of the Louisiana gulf coast area.

American College of Surgeons Not Teaching Body

WHAT is the American College of Surgeons? is a question often asked. The American College of Surgeons is not a teaching institution but an association of surgeons and surgical specialists of competency and of character who are engaged in a common pursuit to improve the service which they are rendering to the public; to better the hospitals and other surgical en-

vironments; to improve surgery that is necessary, and to eliminate careless and unnecessary surgery; to conduct practical research into surgical problems; and to give the public personal acts that will tend to preserve health and prolong life.

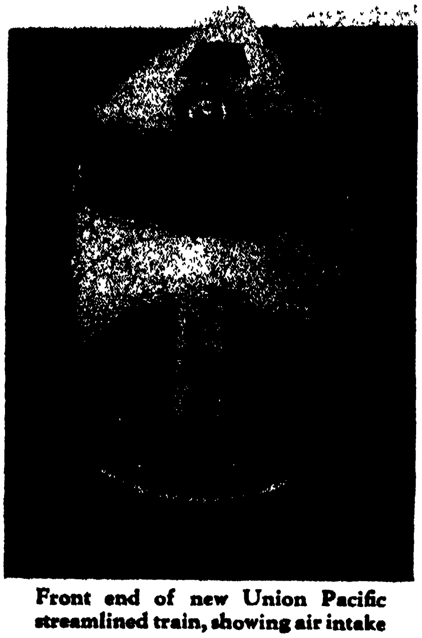
This College of Surgeons is not a political or governmental body. It is a great fraternal organization, guided by public requirements, and universal laws that have resulted from centuries of service.

Each candidate for Fellowship in the American College of Surgeons must furnish positive evidence of preliminary primary and college training; a four or five year course in an approved medical school; a degree of Doctor of Medicine; a license to practice in his community; one to three years of training in a good hospital, or its equivalent; satisfactory assistantship in surgical service; at least seven years of medical and surgical practice; 50 to 80 percent of his work devoted to surgery or a surgical specialty. Above all, he must be morally, ethically, and professionally acceptable.

As practical evidence of his diagnostic, scientific, and professional judgment and his surgical qualifications, he must submit to the College for approval 100 case records of surgical operations which he himself has performed, and finally he must sign a Fellowship Pledge which declares that he does not obtain his patients by paying commissions, or through other unworthy commercial transactions.—*Science Service.*

The Effect of Streamlined Trains on Railroading

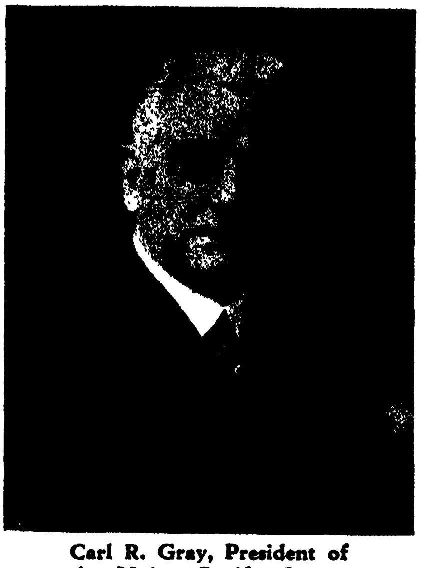
THE new streamlined trains of the Union Pacific differ from the average conventional passenger equipment of today in design, weight, power, speed, and control. These five fundamentals are complementary



Front end of new Union Pacific streamlined train, showing air intake

and interdependent. The results expected to be attained by this departure from the conventional are two-fold: greater comfort and convenience for the traveling public, and lower operating costs.

The first streamlined train, of three cars, was delivered to the Union Pacific in February, 1934. For purposes of exhibition and demonstration it was taken on a tour which extended from coast to coast in which it was subjected to varying operating conditions of gradients, curvatures, climates and altitudes. During this tour, which embraced nearly 13,000 miles and which took the train over the lines of fourteen different American railroads in twenty-two different states, there were no road failures and no accidents and every one of the scheduled 68



Carl R. Gray, President of the Union Pacific System

exhibition stops was made and the train returned to Chicago five minutes ahead of the time set when the tour began some twelve weeks before.

The second train, just being completed, and in which has been incorporated corrections of minor details developed through the testing of the first train, consists of six cars, three of which are Pullman sleepers. The third and fourth trains are on order for delivery this winter. These will consist of nine cars each, four of which will be Pullman sleepers.

As previously mentioned, it is hoped that the new streamlined train will provide greater comfort and convenience to the traveling public and at the same time result in lower operating costs.

Greater comfort on the new train is attained through the fact that the trains are completely air-conditioned and also by reason of complete insulation against the usual vibration and train noises. The articulation of the cars and the employment of roller bearings throughout, together with the cushioning effect obtained by the liberal use of rubber between the trucks and car bodies, improves riding qualities. The lowered center of gravity, while primarily a safety factor, causes the train to "hug the rails" and gives the forward motion a gliding quality.

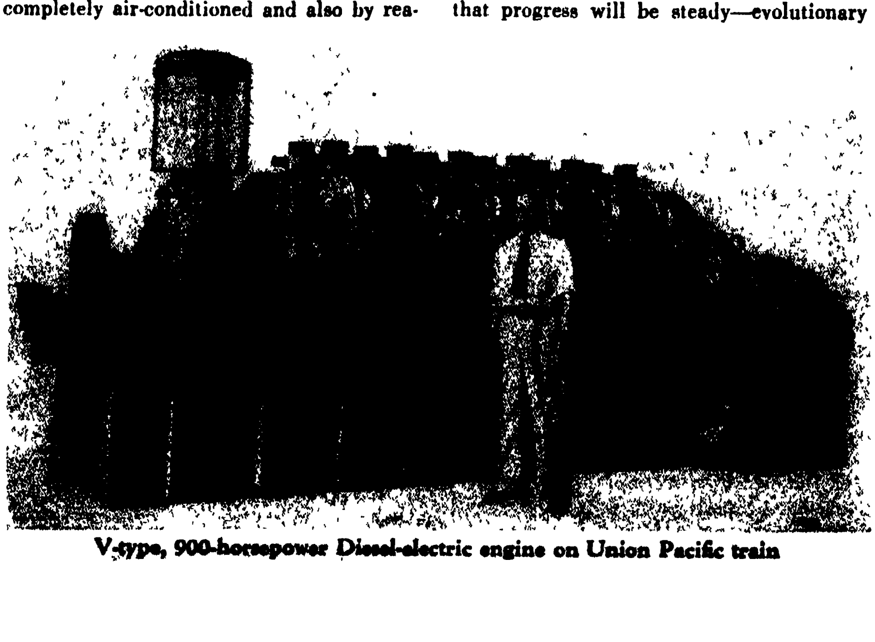
A feature of the Union Pacific streamlined train is the development of a new type of Pullman sleeping car. Each berth, both upper and lower, has a collapsible washbowl. An illuminated mirror in each berth adds greatly to convenience. Every section, every berth in fact, at night is enclosed with sliding aluminum panels, making them individual small rooms and insuring absolute privacy for the traveler. The passenger in the upper berth uses a folding stairway which has a small platform at its top, sufficiently large so that one may stand while dressing.

As to the matter of economy there is involved, first, the question of original cost as compared with present standard equipment, and second, operating costs. Original costs now are necessarily high as these early trains include research, engineering, and laboratory expense. Each train, so to speak, is "tailor-made." Mass-production costs will be quite different. However, the power units of our six-car train and our nine-car trains will pull a transcontinental train all the way from Chicago to the Pacific—a job now done in relay by five steam locomotives, costing 80,000 dollars each. Because of the greater speed, five of the streamline trains will take the place of seven conventional steam trains on a Chicago to Pacific coast schedule.

As to operating costs, there will be no change in the size of crews involved. Fuel costs of the Diesel-electric drive are expected to be one fourth that of steam.

The important still "unknown quantities" are maintenance and depreciation. There will be less servicing enroute during operation and a reduction in periodic overhaul. These new streamlined trains are in process of development and improvements are likely to be made.

I do not foresee any disorganizing and "revolutionary" over-turn in re-equipment of our railways. It seems to me more likely that progress will be steady—evolutionary

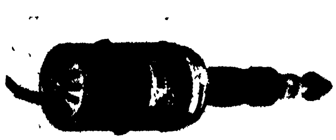


V-type, 900-horsepower Diesel-electric engine on Union Pacific train

rather than revolutionary. Initially at least the streamlined trains will be operated in addition to the present steam train schedules; that is, the present steam trains will not for the near future be displaced. Later, new types of trains will progressively succeed old types on a steady, "normal replacement" basis.—*Carl R. Gray, President Union Pacific System.*

Portable Grinder

A NEW portable electric grinder of the universal type which has a built-in air filter, effectively filtering all air entering the motor, weighs four pounds, turns up 17,000 revolutions per minute, and has ample power to pull a wheel two inches in diameter. The motor housing, of heavy cast aluminum,



Portable grinder for small hand operations, weighing only four pounds

extends out over the motor shaft and air filter, and is encased with an insulating cushion grip, giving positive control and operating flexibility. This new tool, made by the Chicago Wheel and Manufacturing Company, is compact, well balanced, and, with suitable grinding wheel or cutter inserted in the universal case-hardened chuck, will work at an angle and get into and around corners, irregular shaped holes, and other hard to reach places.

The filter is of the viscous type and can be easily removed for cleaning or re-oiling. Tests running over a period of a year in various shops have proved the air filter a most efficient protection for keeping all dust and abrasive matter out of the motor and bearings. Ventilation is in no way impaired even when the filter becomes extremely loaded with foreign matter.

Rubber in Tree Surgery

A PLASTIC rubber tree cavity filler has been perfected as the result of experiments conducted by the Goodyear Tire and Rubber Company and the Akron, Ohio, parks department. The filler readily adheres to the cavities or scars of damaged trees and prolongs their lives indefinitely. Supplementing the cement is a new tree paint for minor cuts and scars that may be used to cover cuts resulting from pruning and trimming.—*A. E. B.*

New Poison Gas Discovered by Accident

A NEW type of "poison gas" that has an even nastier disposition than the hideous concoctions of the World War, was described at the recent meeting of the American Chemical Society in Cleveland, by Dr. George H. Cady. Chemically, this new substance is something of a freak, being composed of nitrogen, oxygen, and fluorine according to the formula NO_2F. Because of its freakish composition it is very unstable and explodes violently when heated. Thus, it would be theoretically possible to flood

(Please turn to page 324)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

FREQUENT demands for instructions for calculating the optical system of a rifle telescope sight led us to invite Alan R. Kirkham, of Tacoma, to prepare an article telling how it is done, and the first half of that article is presented below. Mr. Kirkham is the author of two chapters in "Amateur Telescope Making" and has made a variety of telescopes, eye-pieces, and microscopes. More recently he has undertaken telescope sights, at the request of various riflemen, and with success. If the article which follows is not wholly clear to all readers this may indicate merely that they have not, as they should before attempting a rifle sight, previously made an ordinary refractor from the instructions in "Amateur Telescope Making." A rifle sight is a special case of the refractor. Mr. Kirkham writes:

Telescope Sights

THERE are so many ways of building a telescope sight that to describe any single way is almost certain to invite hearty disapproval if not derision from various sources. However, in the following account, we shall describe a simple method which, beside requiring neither knowledge of mathematics nor tedious computation, has in practice been used to produce sights which have at least no obvious faults. It should be borne in mind that more refined and theoretically superior sights can be designed, but only at a tremendous cost in time spent in ray tracing and analytical calculation. While not extremely difficult, such computation is very complicated and time-consuming, and if the improvement is really only theoretical, its value may be questioned. Should one aspire to such things, the best recourse is to Conrady's "Applied Optics and Optical Design" or kindred treatises, of which the one mentioned is no doubt the most exhaustive.

Figure 1 shows the paths of light rays emanating from an element in the bull's-eye with the rifle expertly aimed. The rays are considered to be parallel up to O, the objective. They converge to a focus F_1, after which they diverge, falling on I and I', the erector lenses, which cause them to converge again to a new focus at F_2. At F_1 the image is inverted, while at F_2 it is erect and is viewed through a low power eyepiece. In order to have the requisite eye distance, this should be a *thin* cemented doublet. The focal lengths of the four lenses are f_1, f_2, f_3 and f_4, respectively. The erector magnification is f_3/f_2, and the focal length of the objective should be multiplied by that value, in order to find the equivalent focal length of the entire sight exclusive of the eyepiece. Calling this F, we have F/f_4 for the magnification with any eyepiece of focal length f_4. If there is a separation between the erector lenses, the distance doesn't count, but once worked out, a variation in their separation will result in different magnification. The use of this property in securing adjustable magnification is nevertheless attended with considerable difficulty, since the whole unit must move as the separation is varied if the telescope is to remain in focus.

The exit pupil diameter is perhaps the best place to begin in finding the diameters of the lenses and stops. In general, a large exit pupil will necessitate a large objective. The exit pupil diameter, d_3, is the effective diameter of the objective, d_1, divided by the magnification. A large exit pupil is therefore obtained with low magnifications, and is desirable for hunting sights where it is inconvenient to take time in getting the eye exactly in line with the telescope. For this class of sights, 2X to 4X with exit pupils 1/4 to 1/6-inch diameter is suggested. For target shooting, smaller exit pupils may be employed, even as small as 1/10 to 1/12 inch, which makes higher powers obtainable. The apparent field of view is about equal to the stop diameter S_2 seen at the eye distance. The diameter of the eyepiece should be equal to the stop diameter plus the exit pupil diameter. The erector lenses should be f_3/f_4 times the exit pupil diameter, after allowing a rim for mounting. If they are separated somewhat, make them a trifle larger and put a stop of that diameter between. The diameter of the stop S_1 is is now f_2/f_3 times that of S_2. The objective diameter is given by

$$\frac{f_1}{f_2}d_2+\frac{f_1+f_2}{f_2}S_1$$

The first part of the expression gives the "effective diameter" mentioned above, while the second part is that which is added for the displacement of the cones of rays from objects at the edge of the field, as shown in Figure 2. The width of any field w, at a distance D (*i.e.*, to a target), is $w=(S_2/F)D$, to a close approximation. Curvature of field depends directly on the focal powers of all the lenses added together, hence very short focus lenses are to be rigorously avoided in any design.

Figure 2 indicates how the lenses should be turned, and also shows the paths of light rays from an object at the edge of the field. Figure 3 gives the construction of each lens. The hatched component represents ordinary flint glass of refractive index 1.615, and dispersion 36.6. The convex lenses may be made from borosilicate crown glass of refractive index 1.517 and dispersion 64.5, or of barium crown having an index of refraction 1.576 and dispersion 57.3. The radii for an aplanatic lens are given in the table in Figure 3, and have only to be multiplied by the desired focal length to obtain working data. The first row is for borosilicate crown and dense flint, as above, and

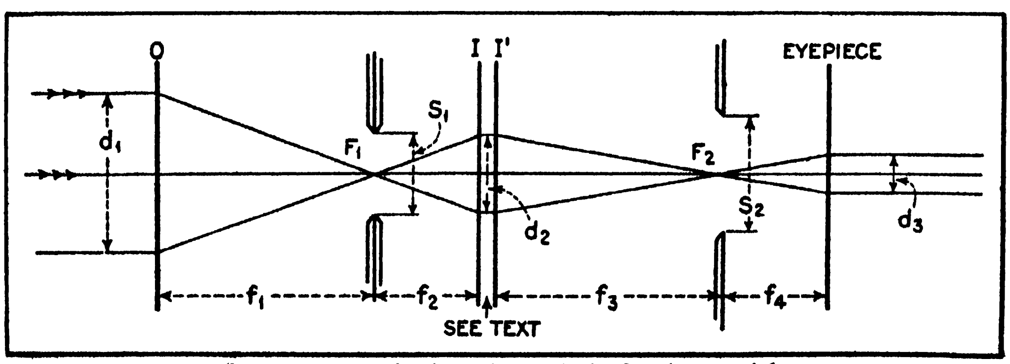


Figure 1: **Ray paths through a typical rifle telescope sight**

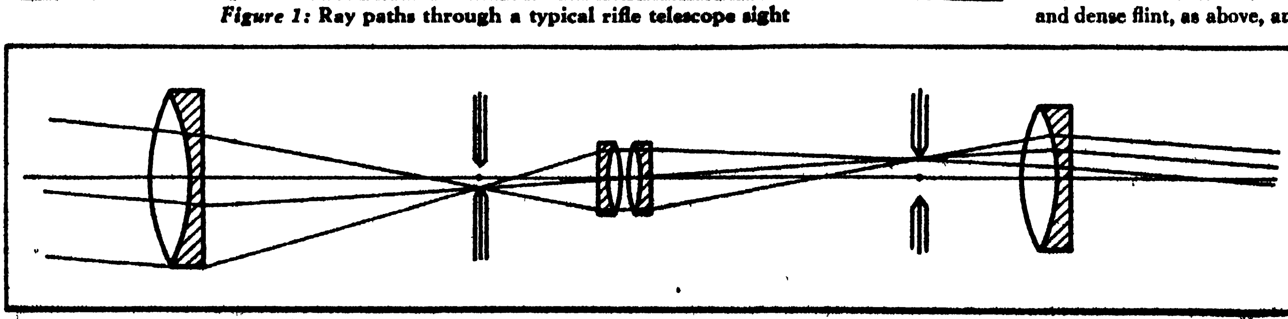
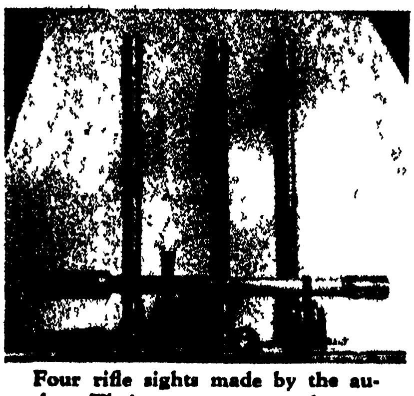


Figure 2: **Diagram of the lenses; also showing rays from objects at edge**



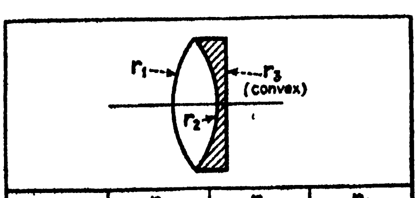
Four rifle sights made by the author. Their mounts, or attachments to rifle, at bottom, are by Lyman

the second is for the barium-crown-dense-flint combination, which has somewhat better color correction, and a considerably flatter field. The barium crown is not as durable, however and requires making more laps.

(*To be concluded.*)

IN the October number we published the Tinsley Laboratories' statement that not 5 percent of the mirrors sent them for silvering were fully polished out. Between the time when that note was inserted and its later appearance, two others wrote us virtually the same statement. B. L. Souther of Pittsburgh, who does silvering, and the American Telescope Company of the same city, who do aluminizing, each state that the great majority of mirrors sent them are far from polished out. Apropos this, J. H. Hindle of England gives the following method of detecting the most minute pits and scratches: Place a lamp at the right of center of curvature, where the pinhole normally goes in the knife-edge test. Then place the eye where the knife-edge would go. Move the head so that just the edge of the cone of reflected rays is seen. Defects of a kind normally seen only on focograms will be rendered visible. Mr. Hindle also commented, when on a recent visit to this country, on our note in the September number, regarding fictitious accuracy in measuring the radii of zones to thousandths of an inch. He does not undertake to measure closer than one 150th inch and believes closer attempts to be self-deceptive.

YOUR scribe complains that dealers omit to send him their catalogs, and leave him guessing where to direct inquirers for this and that. But one—a nice one, at that, with included star charts—has now come in unsolicited from the Optical Research Associates, of Plainfield, New Jersey, and this was so affecting that three big bandanna handkerchiefs were cried soaking wet. Mention of name is for revenge on others, and is not a precedent.



	r_1	r_2	r_3
1	.425	.425	10.00
2	.636	.309	2.825

***Figure 3:* Radius factors (see text)**

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 321)

enemy trenches with it, poisoning all living creatures which breathed it until the gas reached a high enough concentration, at which time a shell, dropped in the gassed area, would cause the whole surrounding "atmosphere" to explode.

According to Dr. Cady: "When a small amount of the compound is inhaled one starts to cough, and a deep breath, even of fresh air, taken after a coughing spell produces still greater irritation in the lungs. In this respect the gas is something like phosgene.

"Although the substance appears quite harmless, being a colorless gas, it has a strong odor and is very reactive chemically. Its most interesting, as well as its most treacherous, characteristic is that it explodes violently when heated.

"The discovery was made during a study of some of the reactions of fluorine, an element something like chlorine. It was found that the reaction with cold, moderately dilute nitric acid produced a gas which could not have been anything previously described in chemical literature. Further research revealed the chemical composition of the compound."

This unpleasant substance was discovered quite by accident and its inventor is not particularly interested in it as an instrument of destruction. Rather, he hopes to find some industrial application in which the gas would be useful as a chemical reagent.—*A. E. B.*

Coal Burning Motor Truck

A RECENT demonstration in the United States of a coal burning steam truck has aroused considerable interest in road transport circles. These trucks are made by an English concern which has been continuously engaged in the production of steam road vehicles for the past 30 years. Thousands of these trucks are in service in England and other foreign countries where they have given satisfactory operation both from the standpoint of economy and reliability.

One of these Sentinel trucks is illustrated in an accompanying photograph. This vehicle has a maximum speed of 50 miles per hour with a normal cruising rate of 30 to 35. The steam generator consists of a cylindrical water tube boiler of 250 pounds pressure which is simple in design and readily taken apart for cleaning and inspection. There are 28 tubes, each two inches in diameter.

Automatic stoking and water level control are provided, permitting operation by one man. The water-tanks and bunkers for fuel are conveniently located in the rear portion of the cab. Sufficient water is carried for a normal run of 40 to 60 miles while the bunkers will hold sufficient fuel for a 150- to 180-mile run.

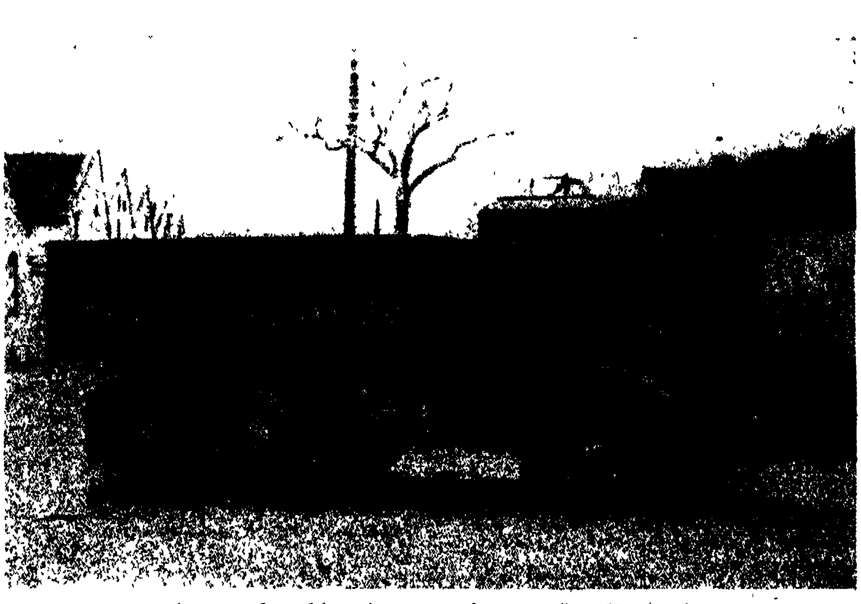
The motor unit is mounted on a three-point suspension carried below the frame and consists of a four-cylinder, 5½-inch bore, 6-inch stroke single-acting engine with cam operated poppet valves. Because of the horizontal mounting of the engine all moving parts are readily accessible. The output is 120 brake horsepower at 600 revolutions per minute. The fuel consumption is stated to be only 4 to 5 pounds of coal per mile.

Due to the flexibility and even torque of the power plant no clutch or gear changes are required.

The vehicle is equipped with two sets of brakes, one set to be applied by hand and the other actuated by steam power controlled by a pedal.

The Last Word in "Freshness"(?)

SO much emphasis has been placed on the "freshness" of coffee by ingenious advertising schemes, that the chemist has evolved a new kink that seems to cap the climax. Purchasers, confused by conflicting claims of freshness, need no longer wonder whether or not they are getting "fresh" roasted coffee, for chemistry is going to tell them as soon as they open the can. Foster D. Snell, prominent consulting chemist, has worked out a chemical indicator for the purpose. As an example, one form of this



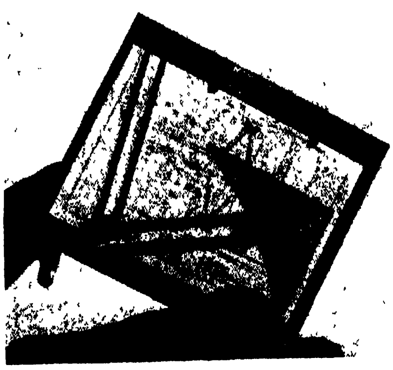
A type of coal-burning steam lorry used in England

indicator, when placed in a vacuum-packed can of coffee, is sensitive to oxygen. Therefore, when the can is opened, if it is a "leaker" the indicator will be pink. If the seal is tight, the indicator will be white, but it will turn pink in about 5 minutes, thus assuring the customer that the can has not been defective and that the coffee has not deteriorated. For foods where deterioration will liberate ammonia, the indicator is similarly a version of the well-known Nessler's reagent. In another form, it detects sulphides.

This system is to be properly visualized as a form of insurance to the customer as to the quality of the product, since the number of cases in which deterioration actually occurs is very small.—*A. E. B.*

A Drawing Board for Field Use

ONE of the accompanying photographs shows the Junior model of the Wrigraph draft block which was developed to meet the need of a low-priced unit for engineers and others, that can be carried in a brief case for convenient use in the field, on the train, in the office, or home. It consists of a board and a parallel device



Small drawing board of many uses

with drawing attachment in a single compact unit. The board is made of 3/16 inch Masonite and is equipped with paper clips which will hold either a single sheet or a pad of letter size paper. No thumb tacks are required.

The parallel device is made of heavy nickel-plated arms, connector, and wrist plates all accurately reamed and assembled with bronze bearings. Either of two drawing attachments is provided. One is a combination of the 30, 60, and 45 degree triangles in one. With it, angles of 15, 30, 45, 60, and 90 degrees can be accurately drawn and other angles can be approximated. The right-angle sides of the device are graduated to 1/8 or 1/10 inch and provide ready drawing edges for horizontal and vertical lines without shifting position. The other drawing attachment consists of a protractor and graduated straight edge which can be set on degrees to any angle required. This is particularly suited for surveying and navigation.

With this device and a pencil compass, even a novice can make accurately dimensioned drawings.

Largest Welded Gasoline Tanker

WITH the launching of the motor tanker *Poughkeepsie-Socony* recently at the Staten Island Plant of United Dry Docks, Inc., the American merchant marine witnessed perhaps the most significant challenge of half a century to ships of less modern design. This vessel, one of the initial units in a 5,000,000-dollar shipbuilding program, is the largest all-welded merchant vessel ever built in the United States and probably in the world.

Nicholas J. Pluymert, Socony-Vacuum naval architect, recently voiced his conviction regarding the electrically-welded ship as follows:

"While the all-welded hull is no newcomer among service vessels of smaller size and Government craft of larger size, there doubtless will be some who will regard as revolutionary the use of that method for such a vessel as the new tanker.

"As ship operators planning to gain the utmost from cheap water transport, we could not overlook the lower first cost of construction nor the fact that at once we save 50 tons in weight, all of which becomes additional cargo space to be used as long as the vessel runs. It is possible that, from this source we might gain a full 'free trip' every year or so.

"The elimination of nearly a quarter of a million rivets and the substitution therefor of 105,000 feet of electric welding is in large part responsible for the weight-saving, but lighter, stronger members also add their proportion to the result," the marine executive explained. "When the time comes that steel fabricators provide appropriately designed shapes for electric welding, I predict new economics that will be even harder to ignore."

The *Poughkeepsie-Socony* is a tanker of typical "canal" characteristics; she is of 1242 gross tons, 260 feet long overall, with 40-foot beam and 14-foot depth. Her cargo capacity is 712,500 gallons and, in addition, she carries some 300 barrels of bunker fuel. Her power plant consists of two Diesel engines of air-injection type, aggregating 750 brake horsepower and driving twin screws. For facility in maneuvering the confined spaces of the New York State Barge Canal, she is equipped with twin rudders. The ship has normal speed of about 10 knots and carries a crew of 18 officers and men.

This latest addition to the Socony-Vacuum fleet will transport gasoline in the Canal-Great Lakes trade where, in normal transit, she will be called upon to pass through locks perhaps 2600 times in a single year. By reason of her bottle-tight construction, many of the hazards of canal transportation commonly associated with rivets will be eliminated, her designers declare.

An Amateur Radio Operator's Record

AN Australian radio amateur has established two-way voice communication with other amateur stations in each of the six continents of the world using a power of less than 10 watts, according to reports received by the American Radio Relay League, an association of amateur radio operators.

The record-breaking operator is G. Pollock, owner of amateur station VK2XU, at 9 Acacia St., Belmore, New South Wales, Australia.

A comparison of the distances covered,

approaching a maximum of 10,000 miles, with the illumination obtained from a 10 watt electric light bulb becomes especially striking when it is considered that commercial radio services use powers a thousand times as great to cover similar distances.

New Urea Plant to be First of Kind in U. S.

ANNOUNCEMENT has been made by E. I. duPont de Nemours and Company, Inc., Ammonia Department, Wilmington, to the effect that a plant for the manufacture of solid urea is under construction at Belle, West Virginia. This plant will be the first of its kind in this country and will have a capacity sufficient to fill the entire domestic demand for urea. The product, to be called DuPont Crystal Urea, will be offered in grades suitable for the various technical uses.

Since September, 1932, the duPont company has manufactured urea-ammonia liquor, a liquid product containing urea and which has attained wide acceptance as an ingredient of mixed fertilizers based on super-phosphate. DuPont Crystal Urea is a logical extension of urea-ammonia liquor manufacture. At present, domestic industry is dependent solely upon Germany for urea supply.—*A. E. B.*

Flexible Plastic "Sandwiches"

MEETING a need for a product that must be "as soft as rubber and long-wearing as Bakelite Resinoid," Synthane Corporation is manufacturing a new material consisting of layers of soft rubber "sandwiched" between sheets of Bakelite. An infinite number of combinations are possible, since the layer thicknesses may be varied, as well as the number of alternating layers of rubber and laminated material.

Many uses suggest themselves. For gasket applications where a combination of axial resiliency with strength and rigidity is required, the material is said to give satisfaction. Vibration-absorbing machine mountings are another important outlet for the product. This is of particular importance today with the trend definitely toward quieter and longer-lived machinery and equipment.

One can visualize the material employed

Bakelite "sandwiches"

for table tops and serving trays, furniture construction, perhaps even for wall paneling. In fact, wherever strength, quietness and resiliency are demanded, this new development holds promise.

Chicken Cannibalism Control

POULTRY raisers report that young chicks have a tendency to pick at everything bright. Often they will pick to death another chick which becomes slightly scratched or injured because they are attracted by the sight of blood.

A poultry authority has conducted some experiments which indicate that blue Cellophane can be successfully used to control this trouble. The Cellophane is simply placed in wooden frames similar to those used for wire screens and then fitted into the windows of the chicken houses. The resulting blue light in the coop makes a spot of blood appear black and hence the chicks are no longer attracted to injured chicks.

Highway Trees Now Coming Back

ROADSIDE tree planting is being revived in New York State. In the early days this practice was almost universal. Nearly every country road had its rows of maples but with the advent of the automobile and modern highway construction no provision was made for shade trees or other roadside beautification. It has taken a great deal of effort on the part of public-spirited citizens of the state to set in motion the resumption of tree planting along the highways, according to the New York State College of Forestry, Syracuse, N. Y.

In 1930 a tree nursery was authorized by the Legislature. This nursery was for the purpose of raising hardwood trees for highway planting. In 1931 the first trees from this nursery were set out on a new road at Hillsdale, Columbia County. Since then approximately 4500 trees have been planted along the highways in the state.

The esthetic improvement of the highways involves many kinds of planting and landscape devices to meet all the varying conditions of roadsides. Some sections require rows of trees, other sections groves or groups of trees, still other sections shrubbery and vines and sometimes all that is necessary is to preserve existing trees.

Experimental work has been started in the prevention of erosion by planting shrubs along steep embankments or cuts made in highway construction and it would appear that with the good beginning already achieved the work of highway beautification will gradually become more extensive, especially in view of the definitely favorable public opinion back of the idea.

Rand Gold Mines Salted

THE gold mines on the Rand, South Africa, are being salted but not in the old way, which was to mislead a possible purchaser. Salt prevents the hatching of hookworm eggs and kills the larvae.

Some 200,000 blacks and 20,000 whites had become afflicted with hookworm. The damp, warm soil of the mines was a perfect laboratory for the breeding of this tiny worm. The authorities first tried all the old

and much thought of disinfectants, such as ill-smelling coal tar. Then somebody remembered that Dr. W. O. Fischer had rediscovered the fact that salt solution, if not below 20 percent, would kill the larvae and the eggs of hookworms. Soon all the corridors, buckets, cages and banisters were scoured with salt solution, and all exposed earth and waste was covered with a layer of salt about an inch thick. This layer in dissolving kills all the larvae and eggs beneath it. Salt also has the advantage of being cheap, odorless and in no way injurious to the health of the workers. Since salt has been used the hookworm count has diminished to a point where the disease is no longer a financial drain on the owners or a physical handicap to the workers.—*Science Service.*

Electrolytic Cell Makes War-Time Antiseptic

DAKIN'S solution, war-time antiseptic for treating infected wounds, may now be easily and satisfactorily made by an electrolytic cell. The apparatus was designed by Dr. O. R. Sweeney of Iowa State College and has been developed for practical use in hospitals by Paul A. Frank of Akron, Ohio.

Dakin's solution, invented by Drs. H. D. Dakin and M. Daufresne during the early days of the World War, is a solution of sodium hypochlorite. Since the War its use in civilian hospitals has been limited by its poor keeping qualities and the fact that it requires considerable skill in its preparation. If it is not strong enough it will not destroy the germs in the wound, and if too strong it will injure the tissues of the body. The difference between too strong and not strong enough is very small.

To overcome the technical difficulties in preparing this solution, Dr. Sweeney designed a simple, practically foolproof apparatus which is now called the antiseptic cell. An electric current controls the chemical reaction so that the resulting solution is of just the right strength. The hospital technician has only to put into the apparatus a measured amount of sodium chloride, distilled water and sodium bicarbonate, and turn on a switch. Fresh hypochlorite solution is then automatically produced at the rate of about an ounce a minute.—*Science Service.*

Rodents Beware

STRANGE uses of oxy-acetylene welding equipment and supplies have been brought to attention from time to time, but it is believed that the following will be hard to beat for a weird use of calcium carbide.

A garage proprietor in the southwest discovered that a handful of carbide put in a prairie dog hole, followed by a gallon of water, is an effective way of cleaning out a prairie dog colony. The owner of the garage possesses several hundred acres of grazing land and says that the rodents infest his country by the thousands. He is going to treat all of his property with carbide as he claims that it has proved successful and cheap, and is superior to any other method he has tried. People in other localities have already heard of this and are planning to try out the method.

A similar situation exists in many western and southwestern golf courses, where the gopher and his ilk are responsible for a large portion of lost golf balls. Undoubt-

edly the fairways committee will find that a few cans of calcium carbide judiciously distributed by the handful and followed up by a plentiful deluge of water will go a long way toward cleaning up this nuisance and removing one source of frayed nerves for the golfer.

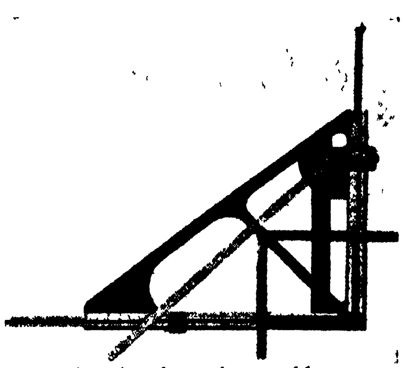
Other reports mention that not a few ants have been destroyed by the same method.

When using carbide as a pest killer don't forget two things: Acetylene gas burns, and when mixed with air in certain proportions it ignites violently, so *don't* try to use it indoors on rats. Secondly, when using the method out-of-doors remember that the carbide residue, if a good deal of water has not been used, may consist both of quicklime as well as slacked lime. So use lots of water, and if cattle, or other domestic animals are about, put it far enough down into the hole so that they can't step into it, or if near the ground surface, cover it with a board. The whole scheme is a grand idea, but use it with intelligence and play safe!—*Oxy-Acetylene Tips.*

The Trianalyst

TO solve numerical algebraic equations by some direct method has been the aim of mathematicians through the centuries. Apparently the goal has been reached through the contrivance of a relatively simple mechanism operated on geometrical principles not heretofore brought to general attention.

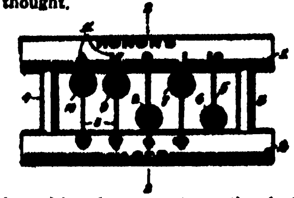
The working model, with Bakelite base and Celluloid scales, weighs about 12



The trianalyst solves problems

ounces. Conveniently sized, its dimensions are sufficient to furnish useful approximations of results. This device is the invention of Barrett R. Wellington of the law firm of Van Santvoord and Wellington, Troy, New York. Long interested in the recreation of mathematical explorations, it seems that, on inscribing a square in the right triangle, he happened on several remarkable theorems. It became apparent that they laid the foundation for entirely new methods of graphical analysis and for a mechanical contrivance that may be used to carry them into effect.

The outstanding theorem is that the area of the square equals the product of the legs, each diminished by the edge of the square. As each factor may, by the sliding scales, be split into terms, a new means of mechanical multiplication and division is brought into existence, with the accompanying advantage of addition and subtraction in combination. This accomplishment opens up new fields of application, since



many of the most important of the higher equations can be easily factored to bring them within the scope of the instrument. It is interesting to note, as can be seen in the illustration, that the sliding "L", in conjunction with the sliding hypotenuse and other scales, is the key to the main functionings of the invention. It enables the operator to adjust the parts so that there is at once represented a right triangle of any shape with its inscribed square, and the readings of all the component parts.

Ordinarily with little, if any, computation, and on a few settings, roots are obtainable generally for quadratics, cubics, biquadratics and certain forms of simultaneous equations. Not a few of these solutions require long, laborious effort by the prevailing methods of today. The Trianalyst also determines with dispatch certain types of formulas involving multiplication, division, addition, subtraction, and the powers of roots of numbers, all in combination. A detachable protractor, as an incidental feature, furnishes the solutions of trigonometrical problems.

CURRENT BULLETIN BRIEFS

Carnegie Institution of Washington Year Book For 1933. An account of the many and varied researches—astronomical, biological, physical and so on—conducted by America's largest institution of general scientific investigation. *Carnegie Institution of Washington, Washington, D. C.—Paper $1.00 postpaid; cloth bound $1.50.*

Handbook of Goodrich Low-Pressure Tires in Farm Service. The tractor has proved of great value in doing away with horse traction and it has proved more effective when equipped with low-pressure pneumatic tires. Study of this pamphlet will post the agriculturist on a new step towards increased profits in agriculture. *Write for Bulletin 12A. Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Making Cider on the Farm is a circular by Prof. W. F. Walsh. Several new ideas for cider making will, it is believed, give a greatly improved product. Carbonation of the clarified cider is recommended as giving a very pleasing drink. *New York State Agricultural Experiment Station, Geneva, New York.—Gratis.*

Rock Crushing Machines. Certain industries require the use of massive, heavy-duty machinery. In the past, lubrication may have been given secondary importance in such machinery—now the trend seems to be towards automatic lubrication. The principal types of crushers are illustrated. *Write for Bulletin 12B to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Animal Books for Children. This series of four books about animals for children is illustrated with "three-dimensional" pictures of groups in the Field Museum. With the aid of a special colored spectacle the groups appear to stand out. The books relate to "The Lion," "The Bear," "Sheep and Goats," and "The Deer." The text is

by H. B. Harte of the Museum staff. *Field Museum of Natural History, Chicago, Ill.—25 cents each plus 3 cents postage. Set $1.00, postage 10 cents extra.*

TEXTILE MACHINERY; IMPROVEMENTS IN DESIGN AND METHODS OF LUBRICATION. Stability in machine performance can be materially influenced by the thought which is given to lubrication when the unit is in the drafting board stage. This is particularly the case with textile machinery which is more or less complicated. *Write for Bulletin 12C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE NEW SCIENCE OF LIGHTING, by Dr. Matthew Luckiesh and Frank K. Moss, presents the results of scientific researches which have extended the viewpoint of lighting and vision into seeing as an activity of human beings operating as seeing-machines. *Write for Bulletin 12D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

GEOLOGIC HISTORY AT A GLANCE, by L. W. and G. L. Richards Jr. Two large charts, in book form, showing in a table, the eras, periods, epochs, and strata of geologic history, with corresponding evolutionary changes in biology. An excellent aid for lecturers since the charts are removable and can be hung on the wall. *Stanford University Press, California.—$1.25.*

FACTORS IN MEASUREMENT OF AIR PERMEABILITY OF PAPER. (Bureau Research Paper No. 682.) A comprehensive definition of air permeability in relation to paper and fiber board. Suggestions are made relative to a standard testing method. *Superintendent of Documents, Washington, D. C. —10 cents (coin).*

INSTRUCTIONS AND RULES FOR CONSUMERS IN TRANSPORTING, STORING, AND USING HIGH EXPLOSIVES AND PERMISSIBLE EXPLOSIVES. Much of the folder is taken up by "Don'ts," giving good advice which is very necessary in handling explosives. The directions for priming, tamping, and firing are fully illustrated. *Institute of Makers of Explosives, 103 Park Ave., New York City. —Gratis.*

CLEAN AIR, AN ACHIEVABLE ASSET. (Reprint from the *Journal of the Franklin Institute.*) We had an article on this subject in our February, 1934 issue. This is a subject which is attracting a great deal of interest in municipal sanitation. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

COMMON WEEDS (Botany Leaflet 17), by Paul C. Standley, gives brief, non-technical accounts of various features of plant life with reference to the botanical exhibits in the Field Museum and to the local flora of the Chicago region. *Field Museum of Natural History, Chicago, Ill.—25 cents.*

SELECTED MOTION PICTURES (SILENT AND SOUND) gives a list of free and rental pictures which are designed to be shown to children and young persons *The Y.M.C.A. Motion Picture Bureau, 347 Madison Ave., New York; 19 South La Salle St., Chicago, Ill.—Gratis.*

Books SELECTED BY THE EDITORS

THE PROGRESS OF SCIENCE

By J. G. Crowther

IN this, the newest book by the author of "An Outline Of The Universe," "The A B C Of Chemistry," "Science For You," and several other popular scientific books as well as SCIENTIFIC AMERICAN articles, we are given an account of recent fundamental research in physics, chemistry, and biology. We are told of the famous Cavendish Laboratory at Cambridge University and the work on atomic physics that goes on there; of the cosmic rays; of diplogen (heavy water); the chemistry of evolution; heredity; and other things scientific. This book fairly well covers the field of recent scientific advance. The author knows his science accurately. His books are suited best to readers having a pretty fair background in science, yet they are popular in nature.—$3.75 postpaid.—*A. G. I.*

MAKING THINGS FOR FUN

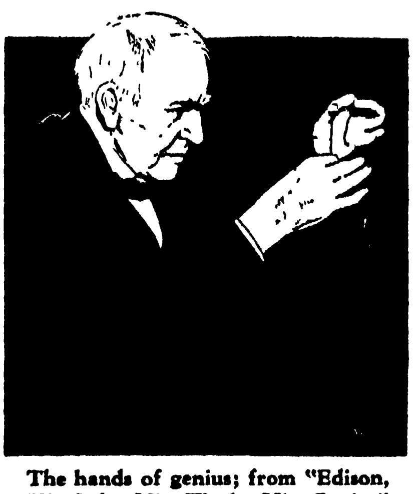
By A. Frederick Collins

THE boy or girl who delights in making his or her own toys will certainly appreciate as a Christmas present a copy of this latest book by Mr. Collins. The author calls this a "how to make" book for boys and girls of all ages. Surely anyone between ten and sixteen years will find much enjoyment in the instructions given for making things from all kinds of material. The instructions range from how to make simple little things from paper to the construction of a miniature stage, a model ship, and a midget radio receiver. Entirely practical in scope, the book will furnish endless entertainment to anyone who likes to see things grow under his own hands.—$2.15 postpaid.—*A. P. P.*

EDISON, HIS LIFE, HIS WORK, HIS GENIUS

By William Adams Simonds

IT is now possible to look back upon the life-time work of Thomas Alva Edison and view it in a perspective which makes possible a more true evaluation of the labors of a man who contributed vastly to our present industrial and social developments. The present author has gone further than usual in books of this type, tracing the history of Edison back to the great grandparents, and giving an historical background which makes possible a highly desirable evaluation. Then comes the story of Edison himself, and many of the myths which have been built up around this great figure are exploded by what appears to be irrefutable documentary evidence. The reader is then led through



The hands of genius; from "Edison, His Life, His Work, His Genius"

trials and tribulations of Edison and his various inventions, the story ending with an account of "Light's Golden Jubilee," and the last work of Edison just before his death. Several pages in the back of the book are devoted to notations regarding the foregoing text and a bibliography which should prove of great interest to anyone desiring to know more of this great American inventor and his work.—$3.70 postpaid.—*A. P. P.*

LANGE'S HANDBOOK OF CHEMISTRY

By Norbert Adolph Lange, Ph.D.

THIS book is the result of a number of years' experience in the compiling and editing of data useful to chemists. It is one of the most usable reference books on the subject we have ever seen. There are 1540 pages of closely condensed matter. There is also an appendix of mathematical tables and formulas contributed by Richard Stevens Burington, Ph.D., which adds materially to the value of the book. Such useful things as a table of chemical journals from 1880 save the researcher infinite time. The services of 70 collaborators are noted and we join with the author in the hope that this book will be of the same usefulness to the worker in science as is the dictionary to the worker in literature, and that its resting place will be on the desk rather than on the book shelf.—$6.25 postpaid.—*A. A. H.*

WIDE ROAD AHEAD!

By Henry B. Lent

WHILE this book was prepared primarily for the youngster who is interested in knowing what makes the wheels go 'round, it will also be read and enjoyed by grown-ups who would like to have a superficial knowledge of the automobile and its manufacture. The text makes no pretense of being technical but rather it tells a readable story of the inception of the automobile, its present development, the assembly line method of manufacture, and the uses of the final product. The entire running story is told in 102 pages of easily read text, supplemented by a series of black and white drawings which are striking in their explanatory simplicity.—$2.15 postpaid.—*A. P. P.*

CITY EDITOR

By Stanley Walker, City Editor, The New York Herald-Tribune

MOTION pictures and fiction stories have given the general public a mental picture of the men who make possible our daily newspapers. Excellent as the clarity of this picture may be, cold facts reveal that it is usually erroneous. Here the facts are told, and told in an intriguing manner by one who is in a position really to know the inside story of life on a newspaper. The author, with a background of years of experience on metropolitan dailies, and thoroughly in love with his work, has recorded the hopes and fears, tragedies and glories of this ancient profession and has put them in their true light, making a story which is truly stranger and more thrilling than any fiction. A swell book in every respect and one which we can truthfully say you will be loath to put aside until you have finished it.—$3.20 postpaid.—*A. P. P.*

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